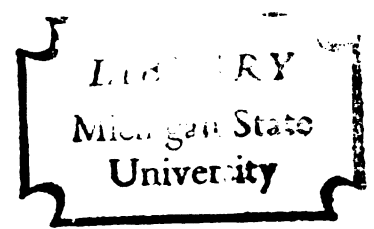


RATIONAL DECISION MAKING:
THREE MODELS

Thesis for the Degree of M. A.
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THESIS



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ABSTRACT

RATIONAL DECISION MAKING: THREE MODELS

by Wayne A. Olin

In this paper I describe what I consider to constitute the conditions for rational decision making. I then describe three models of decision making: the optimizing and satisficing models as formulated by John T. Gullahorn and Jeanne E. Gullahorn and the gain-loss model as formulated by Santo F. Camilleri. I apply the gain-loss model of rational decision making to some questionnaire data collected by John T. Gullahorn, first to a two-alternative situation and then to the three-alternative situation. I conclude from these results that the gain-loss model of rational decision making adequately explains the data from the Gullahorn questionnaire in both the two-alternative and the three-alternative situations.

RATIONAL DECISION MAKING:

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by

Wayne A. Olin

A THESIS

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RATIONAL DECISION MAKING: THREE MODELS

Introduction

Hundreds of times every day, every individual is confronted with the situation where more than one course of action lies ahead of him and he can take only one of the courses of action. Many times the individual does not consciously choose one of the courses of action, but takes a course of action because of factors other than conscious choice. For example, the motorist confronted with a red traffic light does not consciously consider the alternatives of stopping or going through the intersection, but, because of habit, training, or some other unconscious process, he stops. Even though he may realize that not stopping is a possible alternative, he does not say to himself, "If I don't stop I may get involved in an accident or I may get a ticket." He just stops.

The Structure of Decision Making

Many times, however, when the individual is confronted with several alternatives, he does consciously consider the consequences of each alternative and on this basis chooses one of them. I will call this type of behavior decision making. Thus decision making, as I define it, involves three components. First, the individual must realize that

there are at least two courses of action confronting him and that he can only take one of them. Although there may be many courses of action available to the individual, and although he may be unaware of some of them, my definition of decision making necessitates only that the individual be aware of at least two of the available courses of action. Second, the individual must consciously examine each of the alternatives that he is aware of to determine what would be expected of him and what he would expect the consequences to be. Third, the individual must use this conscious examination of the alternatives as the basis for selecting one course of action in lieu of the other alternative courses.

The third criterion for decision making, that the individual bases his decision on a conscious examination of the alternatives, implies that in arriving at his decision the individual uses some sort of reasoning process based on his information about the alternatives. In other words, the individual starts with some information about the alternatives, goes through some reasoning process, and arrives at a decision.

This raises several important questions about decision making. Is this reasoning process roughly the same for all people or is it peculiar to the individual? What is the form that this reasoning process takes? Does the form of the reasoning process vary from decision to decision, and, if so, what are the determinants of the form; is it the situation?

I would hypothesize that the answer to the question of whether the reasoning process in decision making is roughly the same for all people or whether it is peculiar to the individual depends on the situation. In making decisions that are relatively important to him and where the situation appears to be relatively well structured, the individual would use the same reasoning process as would another person under the same conditions. Thus I hypothesize that people making the same important decision in a structured situation will use the same reasoning process, and each person's decision will seem rational to all others under the same conditions. I will call decision making under these conditions rational decision making. In this paper, I will assume that this hypothesis is correct and that situations characterized by rational decision making are identifiable.

Many models of the form of the reasoning process in rational decision making have been suggested. I will present three models of the reasoning process, and I will test one of these models. I would hypothesize that the form of the reasoning process in rational decision making is different for different decisions, and that the form is a product of the importance of the decision and the degree of the structuring of the situation.

A summary of some of what is known or suspected concerning the process of rational decision making and the reasoning process involved is given by Festinger.

When a person is faced with a decision between two alternatives, his behavior is largely oriented toward making an objective and impartial evaluation of the merits of the alternatives. This behavior probably takes the form of collecting information about the alternatives, evaluating this information in relation to himself, and establishing a preference order between the alternatives. Establishing a preference order does not immediately result in a decision. The person probably continues to seek new information and to re-evaluate old information until he acquires sufficient confidence that his preference order will not be upset and reversed by subsequent information. This continued information seeking and information evaluation remains, however, objective and impartial.

When the required level of confidence is reached, the person makes a decision. Undoubtedly, the closer together in attractiveness the alternatives are, the more important the decision, and the more variable the information about the alternatives, the higher is the confidence that the person will want before he makes his decision. It is probably this process of seeking and evaluating information that consumes time when a person must make a decision.¹

Three Models of Rational Decision Making

In this paper I will present three possible models of the relationship between the final preference order of the alternatives held by the person and his decision, i.e., the reasoning process of rational decision making. The first two models, optimizing and satisficing, are discussed by the Gullahorns.² The third model, gain-loss, is the

¹Leon Festinger, Conflict, Decision, and Dissonance (Stanford: Stanford University Press, 1964), pp. 152-153.

²John T. Gullahorn and Jeanne E. Gullahorn, Computer Simulation of Role Conflict, System Development Corporation Paper No. SP-2261 (Santa Monica, California: System Development Corporation, 9 November 1965), pp. 14-16.

product of S. F. Camilleri.³ I will discuss briefly the first two models of rational decision making. I will examine in more detail the gain-loss model and will apply it to some existing questionnaire data as a test of its validity.

If the relationship between the preference order and the decision of the person is optimizing, the person "merely considers the rewards and costs of each alternative and selects the one yielding the greatest profit."⁴ Once the person has a final preference order among the alternatives, he chooses that alternative at the top of the list, i.e., the one with highest preference.

The second model, that of satisficing, is attributed by the Gullahorns to Herbert Simon. When individuals satisfice in decision making, they "look for a course of action that is satisfactory or good enough."⁵ According to this model a person has a "threshold of acceptability," and any alternative having a profit to the person greater than this threshold is "good enough" for the person. The person considers the alternatives according to some order

³Santo F. Camilleri, A Model of Decision-Making in an Exchange Situation, A Paper Presented at the Midwest Sociological Association Meetings, Madison, Wisconsin, April, 1966.

⁴Gullahorn and Gullahorn, p. 14.

⁵Herbert A. Simon, Administrative Behavior (New York: Macmillan Co., 1957), p. xxv.

and the first one that exceeds the threshold is the one he accepts. If none of the alternatives is chosen by this satisficing procedure, the person selects one by the optimizing procedure. The problem with this model comes in determining the order in which the person considers the alternatives.

In a situation involving continuing social interaction, it is reasonable to believe that of the possible courses of action open to a person the first course of action that he would consider in making a satisficing decision would be his present course of action. In this regard, Homans says, "The evidence seems to be that the less their profit, the more likely people are to change their behavior, and to change it so as to increase their profit."⁶ Homans' statement is similar, but not equivalent, to the satisficing decision model. Homans postulates no "threshold of acceptability." He apparently postulates a probabilistic model; as the profit of a person's present course of action decreases, the probability increases that he will choose another, more profitable, course of action.

The Gullahorns have compared the relative usefulness of the optimizing and satisficing decision making models. They have devised a representation of each of these models in their computer simulation model of role conflict

⁶George C. Homans, Social Behavior: Its Elementary Forms (New York: Harcourt, Brace, and World, 1961), p. 99.

resolution. They conclude that the computer simulation model incorporating the satisficing decision model more nearly represents actual survey data concerning a decision situation than does the computer simulation model incorporating the optimizing decision model.⁷ To this point, Simon says, "However adaptive the behavior of organisms in learning and choice situations, this adaptiveness falls far short of the ideal of 'maximizing'. . . . Evidently, organisms adapt well enough to 'satisfice'; they do not, in general, 'optimize.'⁸

As mentioned earlier, I would hypothesize that the form of the reasoning process is dependent upon the importance of the decision and the degree of the structuring of the situation. In comparing the optimizing and satisficing models, I would say that the satisficing model would be more applicable than the optimizing model to that rational decision making characterized by less important decisions in less structured situations; the optimizing model would be more applicable than the satisficing model to that rational decision making characterized by more important decisions in more structured situations. I would characterize the questionnaire that the Gullahorns dealt with as presenting a rational decision making situation containing elements of both types. All of the alternatives were specified, most of the expectations

⁷Gullahorn and Gullahorn, p. 16.

⁸Herbert A. Simon, Models of Man: Social and Rational (New York: John Wiley and Sons, 1957), p. 261.

of the individual and the consequences to him for each alternative were indicated, but the decisions involved could have been considered relatively unimportant to the respondents since the decisions were hypothetical, not real-life, decisions. Whereas I would say that the satisficing model applies to the rational decision making situation of low importance and low structuring and the optimizing model applies to the rational decision making situation of high importance and high structuring, I would say that the gain-loss model applies to rational decision making situation of low importance and high structuring.

This third decision model, the gain-loss model, is the product of S. F. Camilleri. Camilleri postulates that for two alternatives, A and B, the objective probabilities with which each of the alternatives is chosen, denoted $P(A)$ and $P(B)$, are in the same ratio as the total gains from the alternatives; that is

$$\frac{P(A)}{P(B)} = \frac{G(A)}{G(B)}$$

where $G(A)$ is the total gain to the person making the decision from choosing alternative A, and $G(B)$ is the total gain to the person from choosing the other alternative, alternative B.⁹ This model says that the higher the total gain to the person of an alternative in relation to the total gain of the other alternative, the higher will be the probability that the person will choose that alternative.

⁹Camilleri.

According to the optimizing model, the person would choose alternative A with probability equal to 1, i.e., with certainty, if the total gain from alternative A is greater than the total gain from alternative B. The gain-loss model differs from the satisficing model in that no "threshold of acceptability" is hypothesized and no order of consideration is hypothesized. Indeed, no order of consideration would be logical in this situation. Unlike the Homans situation where the person is faced with the decision of whether to continue his present course of action or to choose an alternative one, the Camilleri model applies to the situation where the person is faced with a series of independent decisions. Therefore the person has no reason to tend to choose the same alternative each time; consequently no one alternative would be expected to be considered first.

As previously described, the gain-loss model of decision making applies only to a two alternative situation. This model can easily be extended to cover a multiple alternative decision situation. For an n-alternative situation the probability model would hypothesize the following relationship between the probabilities of the person's choosing each alternative and the total gain of each alternative to the person.

$$\frac{P(1)}{G(1)} = \frac{P(2)}{G(2)} = \frac{P(3)}{G(3)} = \dots = \frac{P(n-1)}{G(n-1)} = \frac{P(n)}{G(n)}$$

This means that the higher the total gain to the person of an alternative in relation to the total gains of the other

alternatives, the higher will be the probability that the person will choose that alternative. In Festinger's terminology, the higher an alternative is on a person's final preference order, the higher will be the probability with which he chooses that alternative.

In presenting the three models of decision making, I have said that alternatives are compared on the basis of their profit or total gain to the person. That is, the individual in a rational decision making situation examines an alternative to see what would be expected of him and also what he could expect the consequences to himself to be if he were to choose that alternative. The individual combines all these considerations somehow into a single indicator, profit or total gain, which is the value of that alternative to him. These concepts of profit, as used by the Gullahorns, and total gain, as used by Camilleri, are not equivalent.

According to Festinger an alternative may have favorable characteristics and unfavorable characteristics. Festinger says that when a person chooses between two alternatives, A and B, the set of all the favorable characteristics of alternative A and of all the unfavorable characteristics of alternative B steer the person in the direction of choosing alternative A. Similarly, the set of all the favorable characteristics of alternative B and of all the unfavorable characteristics of alternative A steer the person in the direction of choosing alternative B. The person is

pushed in two opposite directions at once and is said to be in a state of conflict.¹⁰ Conflict is not to be confused with dissonance; there is no dissonance in the pre-decision process and therefore the person experiences no pressure to reduce dissonance.

These ideas of Festinger's have been formalized by Camilleri. Camilleri calls the favorable characteristics of an alternative (as seen by the individual) the gains to be expected from that alternative, and the unfavorable characteristics of the alternative (as seen by the individual) the losses to be expected from that alternative. Each gain or loss (reward or punishment, having positive or negative utility) may be subjectively certain or probabilistic. Camilleri represents each gain or loss by a component which is a positive or negative real number. If the gain or loss is probabilistic, then the component representing it is the numerical product of two quantities: the subjective probability that the gain or loss will be realized if that alternative is chosen, and a positive or negative number representing the gain or loss to the individual if that gain or loss were certain and that alternative chosen. When the gain or loss is subjectively certain, the component representing it is just a positive or negative number representing the gain or loss to the individual if that alternative were chosen.¹¹

¹⁰Leon Festinger, A Theory of Cognitive Dissonance (Stanford: Stanford University Press, 1957), p. 40.

¹¹Camilleri.

Festinger's characteristics of an alternative are represented by components which are positive or negative numbers. Therefore the favorable characteristics of an alternative are represented by a series of positive components and the unfavorable characteristics by a series of negative components. The favorableness or unfavorableness of each characteristic determines the magnitude of the component representing it. The set of all favorable characteristics of an alternative is represented by the sum of the positive components of the alternative. Likewise the set of all unfavorable characteristics is represented by the sum of the negative components. If we denote the sum of the positive components of alternative A by $A(+)$, the sum of the negative components of A by $A(-)$, the sum of the positive components of alternative B by $B(+)$, and the sum of the negative components of alternative B by $B(-)$, then the force pushing the person toward alternative A is $A(+) - B(-)$, and the force pushing the person toward alternative B is $B(+) - A(-)$. Note that $A(+)$ and $B(+)$ are positive numbers while $A(-)$ and $B(-)$ are negative numbers.

Camilleri calls the force pushing the person toward alternative A the total gain to the person by choosing alternative A, and denotes it by

$$G(A) = A(+) - B(-)$$

He refers to the force pushing the person toward alternative B as the total gain to the person by choosing alternative B, and denotes it by

$$G(B) = B(+) - A(-)$$

As given earlier, the basic postulate of the gain-loss model of decision making is that the probabilities with which a person chooses each of two alternatives, $P(A)$ and $P(B)$, are in a ratio equal to the ratio of the total gains to that person of each of the alternatives, $G(A)$ and $G(B)$. This is represented by the following equation.

$$\frac{P(A)}{P(B)} = \frac{G(A)}{G(B)}$$

Since $P(A)$ and $P(B)$ are probabilities, and since A and B are the only alternatives, it follows that $P(A) + P(B) = 1$. The following are the unique solutions to the two equations given above.

$$P(A) = \frac{G(A)}{G(A)+G(B)} = \frac{A(+)-B(-)}{A(+)-B(-) + B(+)-A(-)}$$

$$P(B) = \frac{G(B)}{G(A)+G(B)} = \frac{B(+)-A(-)}{A(+)-B(-) + B(+)-A(-)}$$

For three alternatives, the basic equation is

$$\frac{P(A)}{G(A)} = \frac{P(B)}{G(B)} = \frac{P(C)}{G(C)}$$

Since $P(A)$, $P(B)$, and $P(C)$ are probabilities and since A , B , and C are the only three alternatives, it follows that $P(A) + P(B) + P(C) = 1$. The following are the unique equations for the probability of each of the alternatives in a three-alternative situation.

$$P(A) = \frac{G(A)}{G(A)+G(B)+G(C)}$$

$$P(B) = \frac{G(B)}{G(A)+G(B)+G(C)}$$

$$P(C) = \frac{G(C)}{G(A)+G(B)+G(C)}$$

While the gain-loss model of decision making uses the concept of total gain, which obviously is based on the ideas of Festinger, the optimizing and satisficing models use the concept of profit which comes from Homans. Festinger states that an alternative may have favorable characteristics and it may have unfavorable characteristics. This means that a person contemplating a certain course of action expects that that course of action will have desirable consequences as well as undesirable consequences.

Homans deals with social interaction. This means that the alternatives of the person's that Homans deals with are whether the person will engage in or terminate social interaction with this person, whether the person will engage in or terminate social interaction with that person, and so forth. Therefore the desirable and undesirable consequences the person will expect from a contemplated course of social interaction are the rewards and punishments that he expects from the person with whom he is contemplating that particular course of social interaction. Although Homans discusses the situation where the other person emits punishments to the person, he does not incorporate this situation in the propositions of his theory of social interaction: "In the exchange of hostilities only one side can win; the other runs away, and it takes two to make social behavior."¹² For this reason Homans does not incorporate the emission of punishments in his theory of social interaction.

¹²Homans, p. 57.

Furthermore, the effect of a punishment is not as predictable as the effect of a reward. The truth of Homans' second proposition seems quite obvious: "The more often within a given period of time a man's activity rewards the activity of another, the more often the other will emit the activity."¹³ The consequences of punishment are not so obvious. A person punished may withdraw from social interaction with the person emitting the punishment. If he remains in social interaction, he may in turn try to punish the other. The frequency of that activity for which the person was punished may increase or it may decrease. If it decreases, there is no way of knowing what alternative activity, if any, will take its place. To complicate matters even more, people don't always seek to avoid punishment; through civil disobedience a person may actively seek punishment in order to protest something he considers unjust.

If Homans' ideas are put in terms of Camilleri's formalization, then it can be seen that Homans deals exclusively with A(+) and B(+), the favorable characteristics, desirable consequences, or rewards of A and B, the two alternatives or courses of social interaction. He does not use A(-) and B(-), the unfavorable characteristics, undesirable consequences, or punishments of A and B, the two alternatives or courses of social interaction.

¹³Ibid., p. 54.

Homans, however, does deal with punishment in the form of cost. No matter which of mutually exclusive alternatives a person chooses, he will not receive the rewards from the alternatives not chosen. These rewards that the person does not receive are a punishment to him; but they are not the result of punishment by any other person. The cost "of a unit of a given activity is the value of the reward obtainable through a unit of an alternative activity, forgone in emitting the given one."¹⁴ Profit is defined as "the difference between the value of the reward a man get by emitting a particular unit-activity and the value of the reward obtainable by another unit-activity, forgone in emitting the first,"¹⁵ i.e., $\text{Profit} = \text{Reward} - \text{Cost}$. Again in terms of Camilleri's formalization, the profit of alternative A, Profit (A), is defined as:

$$\text{Profit}(A) = A(+) - B(+)$$

Similarly,

$$\text{Profit}(B) = B(+) - A(+)$$

This is the profit used in the optimizing and the satisficing models of decision making to represent the value of an alternative to the person making the decision.

It is obvious that the profit used in the optimizing and the satisficing models is not equivalent in definition to the total gain used in the gain-loss model of decision

¹⁴Ibid., p. 60.

¹⁵Ibid., p. 63.

making even though these two concepts are analagous in function, i.e., in their use as indicators of the value of a course of action to the person contemplating that course of action. Whether profit or total gain can better be used to explain decision making behavior is an empirical question. Each concept in its own model might predict equally well.

The gain-loss model of rational decision making has been tested only minimally. In his paper, Camilleri applied the gain-loss model to a two-person, game type, laboratory situation where the participants were asked to make a decision between two alternatives under varying conditions.¹⁶ I will not discuss the experiment in detail, but will mention just that the decision making situation was highly structured, but the importance of the decisions to the participants was probably low. According to the principles enunciated earlier, the gain-loss model would be applicable to this rational decision making situation. Although the number of subjects in the experiment was small (six under one condition and seven under another condition of the experiment), the results were impressive. In order to further test the gain-loss model of rational decision making, I will now apply it to questionnaire data obtained from 148 respondents.

Empirical Application of the Gain-Loss Model: Two Alternatives

In a field study of social tensions in labor union relationships, John T. Gullahorn gathered, among other information, questionnaire data concerning a union

¹⁶Camilleri.

stewardship vs. employees' club office dilemma (see Table 1).¹⁷
 Each of the respondents, 148 members and officers of a local union, was presented the following hypothetical situation:

Assume you are an officer of the Employees' Club, which is largely supported by the company. You believe strongly in the union and attend meetings regularly. Your fellow workers have chosen you to be their Chief Steward, and you wonder whether you should resign from the club office so you can devote your time to the job of Chief Steward. You really haven't time to do both jobs well. You feel responsible for the continued success of a program which you have started for the club, and at the same time you feel obligated to do a good job as Chief Steward.¹⁸

In each of eight situations the respondent was asked to choose one of three alternative courses of action.

Alternative A was to resign from club office.

Alternative B was to resign from position of chief steward.

Alternative C was to retain both positions.

In each of the eight situations the respondent was told that each of three reference group preferred either that he retain the club office or that he retain the position of chief steward. Notice that the alternatives were phrased negatively, i.e., which job, if any, to resign, while the reference group pressures were phrased positively, i.e., which job to retain. Therefore, reference group pressure is either to not choose alternative A or to not choose alternative B. For example in situation (1), all reference

¹⁷ John T. Gullahorn, "Measuring Role Conflict," American Journal of Sociology, 61 (January, 1956), pp. 299-303.

¹⁸ Gullahorn and Gullahorn, p. 6.

Table 1. Union Stewardship vs. Employees' Club Office Dilema:
Frequency Distribution of Responses

Assume you are an officer of the Employees' Club, which is largely supported by the company. You believe strongly in the union and attend meetings regularly. Your fellow workers have chosen you to be their Chief Steward, and you wonder whether you should resign from the club office so you can devote your time to the job of Chief Steward. You really haven't time to do both jobs well. You feel responsible for the continued success of a program which you have started for the club, and at the same time you feel obligated to do a good job as Chief Steward.

In each of the following situations, please check the appropriate space to indicate the action you would be most likely to take.	I would be most likely to do the following		
	Resign from club office (A)	Retain both positions (B)	Resign from position of Chief Steward (C)
<u>An officer of the company tells you that if you continue your good work in the Employees' Club it may lead to a management position. What if--</u>			
1. Both the union Executive Committee and the people you represent as Chief Steward want you to keep the club office.	28	65	55
2. The executive committee wants you to keep the club office--the people you represent want you to serve as steward.	63	53	32
3. The executive committee wants you to serve as steward--the people you represent want you to keep the club office.	43	57	48
4. Both the executive committee and the people you represent want you to serve as steward.	90	36	22

Table 1. Continued

	I would be most likely to do the following		
	Resign from club office (A)	Retain both positions (C)	Resign from position of Chief Steward (B)
<u>Your work as Chief Steward will give you more chance to make a favorable showing before management than will the club office. What if--</u>			
5. Both the executive com- mittee and the people you represent want you to keep the club office.	45	59	44
6. The executive committee wants you to keep the club office--the people you represent want you to ser- ve as steward.	81	48	19
7. The executive committee wants you to serve as steward--the people you represent want you to keep the club office.	57	58	33
8. Both the executive com- mittee and the people you represent want you to serve as steward.	105	32	11
N=148			

group pressure is for the respondent not to choose alternative

A. The eight different situations were the 2^3 or eight combinations of the three binary reference group pressures.

Reference group X was the management.

Reference group Y was the union executive committee.

Reference group Z was the persons represented, i.e., the persons the respondent represented in his hypothetical position as chief steward.

Each of the eight hypothetical situations presented by the questionnaire is highly structured and the decisions asked for are probably not too important to the respondents since the situations are hypothetical and not real-life situations. According to the criteria mentioned earlier, the gain-loss decision model would be applicable to these rational decision making situations.

Before dealing with all three alternatives, I will first apply the gain-loss model of rational decision making to two of the alternatives, A and B. There are two reasons for doing this. If a simple situation is dealt with first, it should be easier for the reader to understand how the gain-loss model is applied to a decision making situation. Also, alternative C presents certain problems which should be faced only after fully understanding the gain-loss model. Therefore, for those respondents who chose either alternative A or B for a particular situation, I will apply the gain-loss model to explain their choosing between alternatives A and B. In this first application of the model, no attempt will be made to explain why the respondents chose A or B over alternative C, but rather why they chose A instead of B or B instead of A. Before doing this, it must first be shown that it is mathematically correct to apply the gain-loss model to two alternatives of a three alternative rational decision making situation.

In considering only two (A and B) of the three alternatives (A, B, and C) we are looking only at those respondents who choose either A or B. Thus any probability statement about the choice of A or the choice of B would be a conditional probability statement. We are interested in the conditional probabilities, $P(A, A \text{ or } B)$ and $P(B, A \text{ or } B)$, i.e., the probability that A will be chosen or that B will be chosen given that either A or B was chosen. These conditional probabilities are evaluated as follows.

$$P(A, A \text{ or } B) = \frac{P(A \& (A \text{ or } B))}{P(A \text{ or } B)} = \frac{P(A)}{P(A \text{ or } B)}$$

Since
$$P(A) = \frac{G(A)}{G(A) + G(B) + G(C)}$$

and
$$P(A \text{ or } B) = P(A) + P(B) = \frac{G(A) + G(B)}{G(A) + G(B) + G(C)}$$

then
$$P(A, A \text{ or } B) = \frac{P(A)}{P(A \text{ or } B)} = \frac{\frac{G(A)}{G(A) + G(B) + G(C)}}{\frac{G(A) + G(B)}{G(A) + G(B) + G(C)}} = \frac{G(A)}{G(A) + G(B)}$$

Similarly,
$$P(B, A \text{ or } B) = \frac{G(B)}{G(A) + G(B)}$$

Thus, the conditional probabilities, in regard to the total gains, for two alternatives in a three alternative situation are the same as the absolute probabilities for the two alternatives in a two alternative situation.

Although there is no difference in the probability equations in regard to the total gains, there is a difference in the definition of the total gains. According to the gain-loss model, the total gain that a person would expect to receive by choosing a particular alternative is, in Festinger's terminology, the sum of the favorable characteristics of the

alternative chosen and the unfavorable characteristics of the alternatives rejected. Thus for the three alternative situation, $A(+)$, $B(+)$, and $C(+)$ are each the sum of the components representing the favorable characteristics of alternatives A, B, and C, respectively; and $A(-)$, $B(-)$, and $C(-)$ are each the sum of the components representing the unfavorable characteristics of alternatives A, B, and C, respectively, and are negative quantities. Then $G(A)$, $G(B)$, and $G(C)$, the expected total gains from alternatives A, B, and C, respectively, are given by the following equations.

$$G(A) = A(+) - B(-) - C(-)$$

$$G(B) = B(+) - A(-) - C(-)$$

$$G(C) = C(+) - A(-) - B(-)$$

The conditional probabilities are

$$P(A, A \text{ or } B) = \frac{A(+) - B(-) - C(-)}{A(+) + B(+) - A(-) - B(-) - 2C(-)}$$

$$P(B, A \text{ or } B) = \frac{B(+) - A(-) - C(-)}{A(+) + B(+) - A(-) - B(-) - 2C(-)}$$

Therefore in dealing with only two alternatives of a three alternative situation, the only components of the third alternative that are involved are its negative components, i.e., $C(-)$. The components making up $A(+)$, $B(+)$, $A(-)$, $B(-)$, and $C(-)$ must be specified for each of the eight decisions posed by the Gullahorn questionnaire. Before doing this, the characteristics of the components must be elaborated on.

The gain-loss model postulates that the ratio of the probabilities with which each alternative is chosen is equal to the ratio of the total gains of those alternatives.

Mathematically, this means that the hypothesized components lie on a ratio scale with an unspecified unit, i.e., only the ratio of each component with the other components enters into the equations. The numerical value used for each component is meaningless; only the ratio of the numerical values used has meaning in the gain-loss model.

Assuming a situation to be characterized by a rational decision making process means that the hypothesized component structure applies to all those making decisions in the situation. However, this does not imply that the ratios of the components are the same for each decision maker in the situation; they may be unique for each person. In order to apply the gain-loss model to data from a number of different individuals, as in the Gullahorn questionnaire data, where only the frequency distribution of choices is known, we must assume that the ratios of the components are the same for all respondents. Note that without this assumption, the gain-loss model cannot be applied to collective data.

Furthermore, it is assumed that the eight decisions asked for in the Gullahorn questionnaire are independent of one another. Of course, two decisions may be considered not independent insofar as the decisions are similar. What is assumed, therefore, is that the act of a person choosing one alternative does not affect the alternative he chooses in his next decision. Nonetheless, we still assume that the reasoning process used by the individual is the same for all eight situations. Indeed, we assume that the ratios of the

components involved in the decisions remain the same for all eight situations.

It is hypothesized that the component structure, i.e., the components representing the desirable and undesirable characteristics of alternatives A and B, for each of the eight situations, are as given in Table 2. These components are defined in Table 3. Since I am assuming that the questionnaire presents eight rational decision making situations, i.e., all respondents use the same reasoning process, my hypothesized component structure applies for all respondents. It should be noted that the five components a, b, x, y, and z used to represent alternatives A and B are all gains, i.e., I assume that in the hypothetical situation presented in the questionnaire a person would not expect either alternative A or B to result in undesirable consequences in any of the eight situations. Therefore for all eight situations,

$$A(-) = B(-) = 0$$

and $A(+)$ and $B(+)$ are the sums of the respective hypothesized components of alternatives A and B given in Table 2.

As indicated in Table 2, I hypothesize that for alternative C the undesirable consequences, i.e., $C(-)$, are the same for all eight alternatives and are represented by the negative component -d. Therefore since $A(-) = B(-) = 0$ and $C(-) = -d$, the equations for the total gains of alternatives A and B can be reduced to the following:

$$G(A) = A(+) - B(-) - C(-) = A(+) + d$$

$$G(B) = B(+) - A(-) - C(-) = B(+) + d$$

Table 2. Reference Group Preference, Percentages, and Components for the Eight Situations: Two Alternatives

Situation	Alternative Rejected by Reference Group: XYZ	Alternative:				Hypothesized Component of C(-)	Frequency of A or B
		A		B			
		Resign Club Office	Observed Hypothesized Percent Components	Resign Chief Stewardship	Observed Hypothesized Percent Components		
(1)	AAA	33.7	a	66.3	b+x+y+z	-d	83
*(2)	AAB	66.3	a+z	33.7	b+x+y	-d	95
*(3)	ABA	47.3	a+y	52.7	b+x+z	-d	91
(4)	ABB	80.4	a+y+z	19.6	b+x	-d	112
*(5)	BAA	50.6	a+x	49.4	b+y+z	-d	89
(6)	BAB	81.0	a+x+z	19.0	b+y	-d	100
*(7)	BBA	63.3	a+x+y	36.7	b+z	-d	90
(8)	BBB	90.5	a+x+y+z	9.5	b	-d	116

*These four situations were used to estimate the parameters.

Note: See text for definitions of Reference Groups and Alternatives, and see Table 3 for definitions of Components.

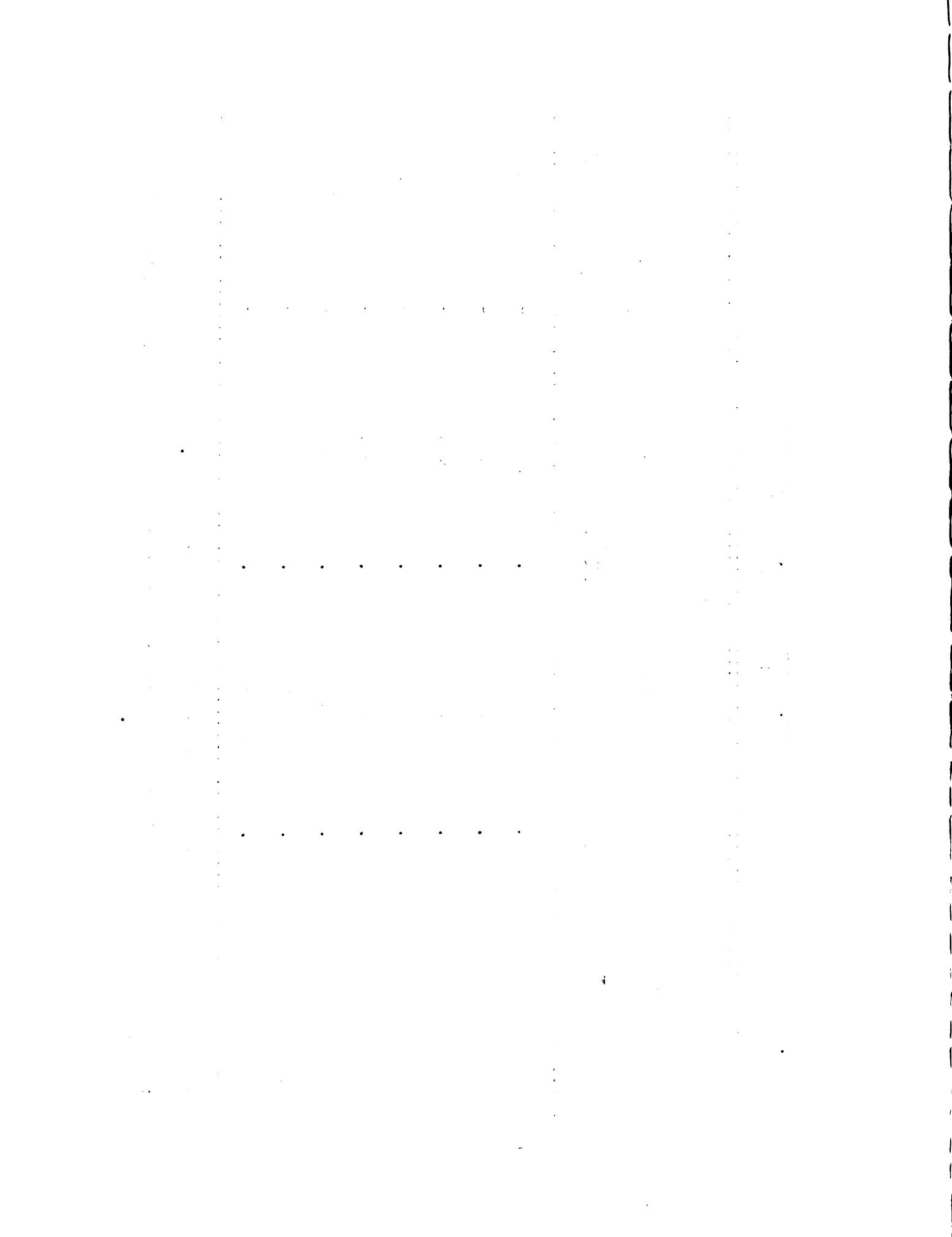


Table 3. Hypothesized Components and Their Definitions

-
- a = the gain expected by the individual from retaining the position of chief steward (he believes strongly in the union, attends meetings regularly, and was elected chief steward by his fellow workers and feels obligated to them).
- b = the gain expected by the individual from retaining the club office (he feels responsible for the continued success of a program which he started for the club).
- d = the loss to self and the negative sanction from the three reference groups expected by the individual for not being able to do both jobs well if he retains both positions (he hasn't time to do both jobs well).
- x = the gain expected by the individual from retaining the position preferred by the management (reference group X).
- y = the gain expected by the individual from retaining the position preferred by the union executive committee (reference group Y).
- z = the gain expected by the individual from retaining the position preferred by the people he represents (reference group Z).
-

Thus the total gain for alternative A for each situation is the sum of the hypothesized components of alternative A for that situation (as given in Table 2) plus d. Likewise the total gain for alternative B for each situation is the sum of the hypothesized components of alternative B for that situation (as given in Table 2) plus d. For example, the total gain to the person choosing alternative B in situation (1) where all three reference groups do not reject alternative B is

$$G(B, 1) = b+d+x+y+z$$

The equations expressing the conditional probabilities for alternatives A and B are as follows.

$$P(A, A \text{ or } B) = \frac{A(+)+d}{A(+)+d+B(+)+d}$$

$$P(B, A \text{ or } B) = \frac{B(+)+d}{A(+)+d+B(+)+d}$$

Notice that the denominators of the conditional probability equations are the same for all eight situations, viz.,

$$A(+)+B(+) = a+d+b+d+x+y+z$$

and the numerators are the entries in Table 2 plus d. Therefore the sum of all the components of a particular alternative in a particular situation (as given in Table 2) plus d divided by $a+d+b+d+x+y+z$ is the probability predicted by the gain-loss model of that alternative's being chosen in that situation. For example, the predicted conditional probability with which a person will choose alternative B in situation (1) where all three reference groups do not reject alternative B is

$$P(B, 1, A \text{ or } B) = \frac{b+d+x+y+z}{a+d+b+d+x+y+z}$$

Since there are two conditional probability equations for each situation, one for alternative A and one for alternative B, and there are eight situations, we now have 16 equations, each utilizing the six components a, b, d, x, y, and z, which specify, according to the gain-loss model of rational decision making, for each of the eight situations, the predicted conditional probability with which a person who did not choose alternative C will choose alternative A or alternative B. Note that for all 16 equations a never occurs without d and similarly b never occurs without d.

Therefore, it is mathematically impossible in these eight situations to arrive at the numerical values of the ratios for all three components a , b , and d . These components will have to be dealt with as only two parameters, $a+d$ and $b+d$, even though they are three separate components. All we need now are the numerical values of the ratios of the five parameters, $a+d$, $b+d$, x , y , and z . Since the values of the ratios of these parameters are not based on theoretical considerations, the only possible source of estimates of these ratios is empirical data. It would be possible to administer questionnaires to a sample from the same population that Gullahorn's respondents were sampled from, viz., members and officers of local unions. These data then could be used to estimate the ratios of the parameters. However, this information is more readily available in the results of Gullahorn's questionnaire survey dealt with here.

The probability equations predicted by the gain-loss model of decision making specify a relationship between the ratios of the parameters and the probabilities with which an alternative will be chosen. Obviously, if the numerical values of the ratios of the parameters are known, the equations can be solved for the numerical values of the probabilities. Similarly, but not so obviously, if the numerical values of probabilities are known, the equations can be solved for the numerical values of the ratios of the parameters. We can use a set of the 16 probability equations with their accompanying observed frequencies to get the values of the

five parameters and then use these parameters in the remaining probability equations to derive a set of predicted probabilities which can be compared with the observed frequencies as a test of the gain-loss model of decision making.

Table 1 presents the frequencies with which each alternative in each situation was chosen by the 148 respondents.¹⁹ Since the gain-loss model deals in probabilities and not frequencies and since in this application of the model we are using only two of the three alternatives, I will use the conditional percentages given in Table 2. These conditional percentages are, for each of the eight situations, the percentage of subjects responding with alternative A and the percentage of the subjects responding with alternative B based on the total number of subjects responding with either alternative A or alternative B.

It is a mathematical theorem that in order to solve a set of equations for the numerical values of the ratios of n unknowns we need a set of $n-1$ linearly independent equations; for five unknowns we need four linearly independent equations. We have 16 equations, but they are not all linearly independent, since $P(A) = 1-P(B)$; i.e., if we know $P(A)$, we can find $P(B)$. Therefore we are left with only eight different equations, one for each situation. This means that we can test the predicted probabilities in four of the situations.

¹⁹Gullahorn, p. 303.

Our problem is which four of the eight situations to use to estimate the parameters since there are many such sets of four which we could use. Although there are eight different equations, there are at most only four of these that are consistent, because the model does not fit the data exactly. If it did, we would have at most four linearly independent equations and all of these would be consistent.

There are many criteria which could be used to select the four situations whose four linearly independent and consistent equations can be used to estimate the values of the ratios of the five parameters. The criterion that will be used here will be that of choosing those situations where the frequencies for alternatives A and B are most equal, i.e., where the conditional percentages in Table 2 are closest to 50%. This criterion will be used to avoid what has been called the ceiling effect. Those situations which do not result in a large number of choices of alternative A or alternative B will be used to estimate the parameters. Thus, in effect, information from the middle ranges will be used to predict the more extreme points. It can be seen that these situations are, in order, (5), (3), (7), and (1) and (2), the latter two being equally close to 50%. Since the conditional probability equation for (1) is not consistent with those for (3), (5), and (7), the equation for (2) will be used. Thus situations (2), (3), (5), and (7) will be used to estimate the parameters, which will then be

used to predict percentages for the four other situations, (1), (4), (6), and (8).

Since it is easier to deal with the parameters if they are given numerical values rather than if their ratios are, I will arbitrarily determine a unit for their ratio scale by letting

$$a+d+b+d+x+y+z = 100$$

Since this is the denominator of the fraction side of all the probability equations, the numerators of the fraction side of the probability equations (the sum of the hypothesized components given in Table 2 for a particular alternative of a situation plus d) equal the observed percentages (the fraction choosing an alternative times 100). For example, for situation (2), alternative A, the model predicts that

$$P(A, 2, A \text{ or } B) = \frac{a+d+z}{a+d+b+d+x+y+z}$$

Since we let the denominator equal 100, this equation becomes

$$100 \cdot P(A, 2, A \text{ or } B) = a+d+z$$

This equation illustrates a point that I made earlier. The equations predicted by the gain-loss model of rational decision making can be used in either of two ways: to predict probabilities or to estimate (predict the values of) parameters. If we already had an estimate of $a+d+z$, where we assume that $a+d+b+d+x+y+z = 100$, we could predict $P(A, 2, A \text{ or } B)$. If we already had the observed percentages we could use them to get the value of $100 \cdot P(A, 2, A \text{ or } B)$ and therefore an estimate of $a+d+z$, where we assume that $a+d+b+d+x+y+z = 100$. I will use this equation from

situation (2) to estimate the parameters. Note that 100 times $P(A, 2, A \text{ or } B)$ is the percentage of the times that alternative A is chosen in situation (2). Therefore using Table 2 we get the prediction that

$$100 \cdot P(A, 2, A \text{ or } B) = 66.3 = a+d+z$$

and we have the following estimate of the sum of two of our parameters $a+d$ and z .

$$a+d+z = 66.3$$

By using the probability equations for alternative A in situations (2), (3), (5), and (7) and by using the observed percentages given in Table 2 and by setting the denominator equal to 100 in order to fix the unit of the ratios of the parameters, we have the following five equations.

$$100 \cdot P(A, 2, A \text{ or } B) = 66.3 = a+d+z$$

$$100 \cdot P(A, 3, A \text{ or } B) = 47.3 = a+d+y$$

$$100 \cdot P(A, 5, A \text{ or } B) = 50.6 = a+d+x$$

$$100 \cdot P(A, 7, A \text{ or } B) = 63.3 = a+d+x+y$$

$$a+d+b+d+x+y+z = 100$$

Solving these equations, we obtain the following estimates of the five parameters.

$$a+d = 34.6$$

$$b+d = 5.0$$

$$x = 16.0$$

$$y = 12.7$$

$$z = 31.7$$

We should remember that these numerical values of the five parameters are based on an arbitrary and meaningless unit and therefore the numerical values of the parameters

are meaningless and are not unique, e.g., the set of numbers (69.2, 10.0, 32.0, 25.4, 63.4) could be used. Only the ratios of the values for the five parameters are unique and have meaning. For example, the following four ratios have meaning and their numerical values are uniquely determined by the four probability equations used.

$$\frac{a+d}{b+d} = 6.92$$

$$\frac{b+d}{x} = .31$$

$$\frac{x}{y} = 1.26$$

$$\frac{y}{z} = .40$$

To simplify computations, the denominator will be set equal to 100 and the numerical values for the five parameters given previously will be used. Now that we have numerical values for the five parameters, we can predict the conditional percentages with which each alternative is chosen in the four remaining situations, viz., (1), (4), (6), and (8). Making use of the fact that the predicted percentages, $\text{Pred\%}$, of an alternative equals 100 times the predicted probability, we obtain the following predictions for situations (1), (4), (6), and (8) respectively.

$$\begin{aligned} \text{Pred\%}(A, 1, A \text{ or } B) &= 100 \cdot P(A, 1, A \text{ or } B) = a+d &= 34.6 \\ \text{Pred\%}(B, 1, A \text{ or } B) &= 100 \cdot P(B, 1, A \text{ or } B) = b+d+x+y+z &= 65.4 \end{aligned}$$

$$\begin{aligned} \text{Pred\%}(A, 4, A \text{ or } B) &= 100 \cdot P(A, 4, A \text{ or } B) = a+d+y+z &= 79.0 \\ \text{Pred\%}(B, 4, A \text{ or } B) &= 100 \cdot P(B, 4, A \text{ or } B) = b+d+x &= 21.0 \end{aligned}$$

$$\begin{aligned} \text{Pred\%}(A, 6, A \text{ or } B) &= 100 \cdot P(A, 6, A \text{ or } B) = a+d+x+z &= 82.3 \\ \text{Pred\%}(B, 6, A \text{ or } B) &= 100 \cdot P(B, 6, A \text{ or } B) = b+d+y &= 17.7 \end{aligned}$$

$$\begin{aligned}\text{Pred\%}(A, 8, A \text{ or } B) &= 100 \cdot P(A, 8, A \text{ or } B) = a+d+x+y+z = 95.0 \\ \text{Pred\%}(B, 8, A \text{ or } B) &= 100 \cdot P(B, 8, A \text{ or } B) = b+d = 5.0\end{aligned}$$

These predicted conditional percentages along with the observed percentages (from Table 2) are repeated in Table 4 for purposes of comparison.

Table 4. Predicted and Observed Percentages Compared: Two Alternatives

Situation	Alternative :				Differ- ence
	A		B		
	Predicted Percent	Observed Percent	Predicted Percent	Observed Percent	
(1)	34.6	33.7	65.4	66.3	.9
(4)	79.0	80.4	21.0	19.6	1.4
(6)	82.3	81.0	17.7	19.0	1.3
(8)	95.0	90.5	5.0	9.5	4.5

It should be noted that since

$$\text{Pred\%}(A, A \text{ or } B) = 100 - \text{Pred\%}(B, A \text{ or } B)$$

only four predictions are made (one for each situation) and not eight (as it might appear). For this same reason, the differences between observed and predicted percentages are of the same magnitude for both alternatives for each of the four situations. These differences are given in Table 4.

It appears from the size of the differences that the four predictions are indeed quite accurate; they range from .9 to 4.5 with a mean of 2.0 percentage points. Since the distribution of the observed conditional percentages for

each alternative of each situation is not known and since there is no basis for assuming that it is any particular distribution, no statistical test of the significance of the differences between the predicted and the observed percentages will be performed. In lieu of a statistical test of significance, I conclude that the predictions look very good.

In arriving at these predictions, situations (2), (3), (5), and (7) were used to estimate the parameters. These situations were selected on the basis of the criterion of using those situations where the frequencies of alternatives A and B were most equal. Other criteria could be used. As a result, different situations might be used to estimate the parameters and also a different accuracy of prediction might be obtained. For example, the criterion of selecting those situations where the largest number of respondents chose either Alternative A or alternative B could have been used. As can be seen from Table 2, using this criterion would result in selecting situations (3), (4), (6), and (8) to predict for situations (1), (2), (5), and (7). The conditional probability equation for situation (2) is not consistent with those of situations (4), (6), and (8). Therefore, situation (3) would be used, since it is the next situation specified by the criterion. Using this criterion would result in differences between predicted and observed percentages of 4.1, 4.6, 2.7 and 5.9 for situations (1), (2), (5), and (7), respectively. The average of these differences is 4.3

percentage points. Although the predictions obtained by using the second criterion are not as accurate as those obtained by using the first criterion, they are still quite good.

There are probably other criteria that could be used and certainly many other sets of four situations (54 to be exact) that have consistent conditional probability equations. The accuracy of the predictions based on these 54 other sets of situations will not be determined. However, it should be reported that situations (1), (4), (6), and (8) give errors for situations (2), (3), (5), and (7) of 4.6, 4.1, 6.8, and 10.1, respectively, with a mean difference of 6.4 percentage points. Although these predictions are still less accurate than those obtained by using the first criterion, they are still good. It appears to me that the predictions resulting from this last set of criterion are less accurate than those resulting from any of the other possible sets of situations.

I conclude from these results that, using the component structure hypothesized, the gain-loss model of rational decision making adequately explains the Gullahorn questionnaire data for two of the three alternatives.

Empirical Application of the Gain-Loss Model: Three Alternatives

We now turn to the problems posed by alternative C and also of applying the gain-loss model to all three alternatives, i.e., predicting for each person making a decision

in one of the situations of the Gullahorn questionnaire whether he will choose alternative A or alternative B or alternative C.

In all eight situations the respondent is told that each of the three reference groups prefers that he retain either the club office or the position of chief steward, but never that it prefers both.²⁰ For example, the respondent is not told that reference group X prefers alternative A, but that it does not prefer (i.e., rejects) alternative B; therefore, we would infer that reference group X prefers either alternative A or C. This means that in general whether a reference group rejects alternative A or rejects alternative B doesn't matter with regard to alternative C; it always prefers alternative C (along with another alternative).

It is hypothesized that the gain expected by the individual from retaining both positions (alternative C) is not the sum of the gain expected by the individual from retaining the position of chief steward and the gain expected by the individual from retaining the club office. It is hypothesized that the gain from retaining both positions is greater than the sum of the gains from retaining either position. The additional gain to the individual comes from having avoided a conflict situation. He gains by retaining both positions in not having to choose which position to resign. Therefore we hypothesize that a seventh component is involved in the eight decisions asked for in the Gullahorn questionnaire, viz., component c as defined in Table 5.

²⁰Gullahorn and Gullahorn, p. 6.

Table 5. Additional Hypothesized Components and Their Definitions

-
-
- c = the gain expected by the individual from not having to choose which position to resign.
- u = the gain expected by the individual from the management (reference group X) for retaining both positions when the management wants him to retain the club office.
- v = the gain expected by the individual from the executive committee (reference group Y) for retaining both positions when the executive committee wants him to retain the club office.
- w = the gain expected by the individual from the people he represents (reference group Z) for retaining both positions when the people he represents want him to retain the club office.
-

As with the parameters a+d and b+d, the components a, b, and c cannot be mathematically separated. Therefore their sum, a+b+c, will be dealt with as one parameter.

As mentioned above, we might logically assume that the person would expect to receive a gain from a reference group by choosing alternative C no matter which alternative the reference group rejected, i.e., regardless of the situation. For this reason we might hypothesize that the components of alternative C would be the same for all eight situations, viz.,

$$a+b+c+x+y+z$$

Since there are no negative components in either of the other alternatives for each of the eight situations, the following would be true for all eight situations.

$$G(C) = C(+) = a+b+c+x+y+z$$

The gain-loss model hypothesizes that the probability

with which alternative C would be chosen from among the three alternatives A, B, and C is

$$P(C) = \frac{G(C)}{G(A)+G(B)+G(C)}$$

It was shown earlier that

$$G(A)+G(B) = a+d+b+d+x+y+z$$

for each of the eight situations. Therefore, for each of the eight situations and according to the above hypothesized component structure for alternative C, the probability equation for alternative C would be

$$P(C) = \frac{a+b+c+x+y+z}{a+d+b+d+x+y+z+a+b+c+x+y+z}$$

Thus the gain-loss model would predict that the probability with which alternative C is chosen is the same for all eight alternatives. By looking at the observed frequencies with which alternative C was chosen in the Gullahorn survey as given in Table 1, you can readily see that this prediction is false. The frequencies range from 32 to 65 for 148 respondents.

There are three possible explanations for the failure of the gain-loss model in this case; the gain-loss model is not a true model of reality; or incorrect component structures were hypothesized due to a faulty analysis of the situations; or the data were improperly interpreted.

In regard to the second possible explanation, the Gullahorns point out the following.

In terms of Homans' theory we reasoned that in a situation involving cross-pressures from highly valued

reference groups, the personal cost of forgoing the expected rewards from incumbancy in either position might be so high as to preclude the respondent's realizing a profit from favoring one role at the expense of the other. In such a case we predicted that the respondent would choose what we considered a desperation alternative--that is, he would retain both positions though aware that he could not do both jobs well.²¹

This would mean that alternative C should include an additional positive component in those situations where there were cross-pressures from reference groups. Doing this, however, would not account for the fact that the frequency of choosing alternative C was highest in situation (1) where there were no cross-pressures at all.

Instead, I think the third explanation, that the data were improperly interpreted, is the actual one. Looking at the observed frequencies for alternatives B and C in Table 1, one notices that they are highly correlated. In fact, the Spearman rank order correlation coefficient for alternatives B and C over the eight situations is +.90. We could interpret this to mean that alternatives B and C were viewed by the respondents as having the same types of favorable characteristics. Although this is not a perfect explanation, it is a reasonable one. If it is true, then the failure of the model is due to causes other than the model. The first explanation, that the gain-loss model is not a true model of reality, is not necessary and the probabilistic model of decision making is not proved false.

²¹Ibid., p. 5.

One may well ask why would alternatives B and C be viewed as equivalent sources of favorable characteristics. I would hypothesize that since the respondents were union members and officers, they would value being chief steward much more than holding the company club office. When the reference group pressure was to remain as chief steward, they readily rejected the club office. When the reference group pressure was to retain the club office, many respondents, rather than give up the position as chief steward elected to retain both positions.

But all is not rosy. Based on the total frequencies with which either alternative B or C was chosen, a smaller percentage (54%) chose to retain both positions (alternative C) when all the reference group pressure was toward retaining the club office (situation (1)) than the percentage (76%) who chose to retain both positions (alternative C) when all the reference group pressure was toward retaining the position of chief steward (situation (8)). These variations in alternative C could be explained by noting that frequencies for alternative C are less variable than those for alternative B. This would imply that alternative C is composed of a relatively large constant component $(a+b+c)$ plus components analagous to those for alternative B for the situation. Thus three additional components u , v , and w are hypothesized as defined in Table 5. Using these components, the components of alternative C for situation (1) are

$$a+b+c+u+v+w-d$$

and for situation (2) they are

$$a+b+c+u+v-d$$

and so forth. For the eight situations, the components of alternative C are given in Table 6 which also repeats the components of alternative A and alternative B from Table 3. When the model was applied to the two alternatives, all the components for alternatives A and B were positive, i.e., $A(-) = B(-) = 0$. This is also the case when the model is applied to all three alternatives. Therefore, the total gain from alternative C is the sum of the components for that alternative as given in Table 6. The numerator of the probability equation for alternative C for a particular situation is the sum of the positive components for that alternative of that situation as given in Table 6. The denominator is the sum of all the total gains for all three alternatives of that situation. For example, the probability equation of alternative C of situation (1) is

$$P(C, 1) = \frac{a+b+c+u+v+w}{a+d+b+d+x+y+z+a+b+c+u+v+w}$$

and the probability equation of alternative C of situation (2) is

$$P(C, 2) = \frac{a+b+c+u+v}{a+d+b+d+x+y+z+a+b+c+u+v}$$

Notice that the denominator is not the same for all situations as it was in the two-alternative case. The numerators of the probability equations for alternatives A and B are the same as for the two alternative conditional probability equations. The denominator is the sum of the total gains for all

Table 6. Reference Group Preferences, Percentages, and Components for the Eight Situations: Three Alternatives

Situation	Alternative Rejected by Reference Group: XYZ	Alternative:		
		A	B	C
		Observed Hypothesized Percent Components	Observed Hypothesized Percent Components	Observed Hypothesized Percent Components
(1)	AAA	18.9 a	37.2 b+xy+yz	43.9 a+b+c+u+v+w-d
*(2)	AAB	42.6 a+z	21.6 b+xy	35.8 a+b+c+u+v-d
*(3)	ABA	29.1 a+y	32.4 b+x+yz	38.5 a+b+c+u+w-d
(4)	ABB	60.8 a+y+z	14.9 b+x	24.3 a+b+c+u-d
*(5)	BAA	30.4 a+x	29.7 b+y+yz	39.9 a+b+c+v+w-d
(6)	BAB	54.7 a+x+yz	12.8 b+y	32.4 a+b+c+v-d
*(7)	BBA	38.5 a+x+y	22.3 b+yz	39.2 a+b+c+w-d
(8)	BBB	70.9 a+x+y+yz	7.4 b	21.6 a+b+c-d

*These four situations were used to estimate the parameters.

three alternatives for that particular situation. For example, the probability equations for alternatives A and B of situation (1) are

$$P(A, 1) = \frac{a+d}{a+d+b+d+x+y+z+a+b+c+u+v+w}$$

$$P(B, 1) = \frac{b+d+x+y+z}{a+d+b+d+x+y+z+a+b+c+u+v+w}$$

We now have 24 probability equations. Since

$$P(C) = 1 - P(A) - P(B)$$

eight of the equations are not independent of the other 16 equations. But we do have 16 independent equations. We also have nine parameters, $a+d$, $b+d$, $a+b+c$, x , y , z , u , v , and w . If we use a set of eight independent equations of four of the situations and their associated observed frequencies and fix the unit of their ratio scale by specifying that

$$a+d+b+d+x+y+z = 100$$

we can then get non-unique estimates of the nine parameters.

Again we are faced with the problem of selecting the situations whose probability equations will be used to estimate the parameters. A criterion similar to the one used before will be used here. Those four situations where the frequency of the least chosen alternative and the frequency of the most chosen alternative are closest together will be used. In this way the extremes will be avoided in estimating the parameters. The four situations meeting this criterion are situations (2), (3), (5), and (7), the four used for this purpose before. Using the probability equations for these situations, I obtained the following estimates of the parameters.

$a+d = 34.6$	$x = 16.0$	$u \pm 0.0$
$b+d = 5.0$	$y = 12.7$	$v = 1.9$
$a+b+c = 53.8$	$z = 31.7$	$w = 10.7$

Several points should be made about these non-unique estimates of the nine parameters. Since the same situations were used here as earlier and the unit was fixed by the same equation, the estimates of $a+d$, $b+d$, x , y , and z are the same here as earlier. In solving the equations, the actual value of u that was obtained was -1.9 , which is contrary to the model and the hypothesized component structure since u represents a gain. There are two explanations of this unexpected negative quantity. First, the hypothesized component structure does not adequately represent the favorable and unfavorable characteristics of the three alternatives in each situation. Perhaps the gain represented by c should be a function of the reference group pressure instead of a constant as it is now. The second explanation is that the negative quantity results because the model does not fit the data exactly. As mentioned earlier, different estimates are obtained when a different set of situations is used. Possibly u is quite small and the looseness with which the model fits the data resulted in a negative component. This second explanation is further supported by the fact that when situations (4), (6), (7), and (8) are used to estimate the parameters, u has a small positive value. This second explanation will be considered as true and u will be set equal to zero.

Although the values of a, b, c, and d were not obtained (another situation would have to be used, thus reducing the number of situations for which to predict the results of the decisions), their ranges can be. It can be shown that a is in the range (29.6 to 34.6), b is in the range (0.0 to 5.0), c is in the range (14.2 to 24.2), and d is in the range (0.0 to 5.0). This would indicate that the individual expects to receive much more gain by retaining the chief stewardship and resigning the club office than by retaining the club office and resigning the chief stewardship. The expected loss from not doing both jobs well is low. And the expected gain from not having to choose which position to resign is large.

Using these estimates of the nine parameters, I derived the predicted probabilities of each of the three alternatives for situations (1), (4), (6), and (8). The predicted percentages along with the observed percentages are reported in Table 7.

The predictions given in Table 7 look quite good. The differences between observed and predicted percentages range from 1.3 to 13.4 percentage points with an average of 5.2 percentage points. Again, since the distribution of the responses is unknown, no statistical tests will be performed on the predicted and observed percentages. I conclude from these results that the gain-loss model of rational decision making adequately explains the data from the Gullahorn questionnaire when applied to all three alternatives. Thus further support is given to the validity of the gain-loss model

Table 7. Predicted and Observed Percentages Compared: Three Alternatives

Situation	Alternative:					
	A		B		C	
	Predicted Percent	Observed Percent	Predicted Percent	Observed Percent	Predicted Percent	Observed Percent
(1)	20.8	18.9	39.3	37.2	39.9	43.9
(4)	51.4	60.4	13.6	14.9	35.0	24.3
(6)	52.9	54.7	11.4	12.8	35.7	32.4
(8)	61.8	70.9	3.3	7.4	35.0	21.6

N = 148

as a model of rational decision making. If other situations were used to estimate the parameters, different prediction accuracy would be obtained, e.g., using situations (4), (6), (7), and (8) to estimate the parameters, the errors in the predictions (to one significant figure) range from 0 to 6 with an average of 3.3 percentage points. However, no attempt was made to examine the other 54 sets of four situations to get a range of the prediction accuracy of the gain-loss model applied to the Gullahorn questionnaire.

Conclusions

The predictions of the model would not have been valid if I had used the component structure of alternative C as originally conceived. Only after including the components u, v, and w did the model give valid results. Thus the gain-loss model can be heuristic in the finding of additional, important components of an alternative. However, this can be carried too far. If enough parameters are used almost any mathematical model will "fit" any data. Care should be taken that all parameters used have a sound theoretical basis for their use.

It appears that the parameters used in the application of the probabilistic model to this three-alternative case have a relatively high degree of theoretical soundness. It also appears that the gain-loss model itself has a relatively high degree of validity when applied to these data and possibly for a large class of decision making situations. What does this all mean?

It means that there is a class of rational decision making situations, as typified by those in the Gullahorn questionnaire, which can be adequately explained by the gain-loss model. And it means that the validity of the assumptions of the gain-loss model is supported for this class of rational decision making situations. The assumptions of the gain-loss model are that the individual making a decision (1) analyzes the favorable and unfavorable characteristics of each alternative, (2) treats a gain foregone as a loss and a loss avoided as a gain, and (3) chooses each alternative with a probability proportional to its total gain (the sum of the favorable characteristics of the alternative and the unfavorable characteristics of the other alternatives). And the gain-loss model also assumes that (4) the ratios of the components used to represent these favorable and unfavorable characteristics are constant over very similar rational decision making situations. Thus, the validity of these four assumptions is given support.

Several questions are raised by this analysis. What are the characteristics of the class of rational decision making situations for which the gain-loss model is applicable? Are they characterized, as I have hypothesized, by a high degree of structuring and a low degree of importance? Is rational decision making ever a deterministic process? For different individuals in the same decision making situation, is the decision process ever probabilistic for some, but deterministic for others? And if so, what principles of individual

psychology and group dynamics lead to probabilistic and deterministic decision making processes? Many decisions are made by groups of people; can the probabilistic model be extended to this situation? Further extension and application of the probabilistic model might answer these and other questions concerning the basic process underlying all social organization and much of individual psychology, decision making.

List of References

- Camilleri, Santo F. A Model of Decision-Making in an Exchange Situation. A Paper Presented at the Midwest Sociological Association Meetings, Madison, Wisconsin, Spring, 1966.
- Festinger, Leon. A Theory of Cognitive Dissonance. Stanford: Stanford University Press, 1957.
- _____. Conflict, Decision, and Dissonance. Stanford: Stanford University Press, 1964.
- Gullahorn, John T. "Measuring Role Conflict," American Journal of Sociology, 61 (January, 1956), pp. 299-303.
- Gullahorn, John T. and Gullahorn, Jeanne E. Computer Simulation of Role Conflict Resolution, System Development Corporation Paper No. SP-2261. Santa Monica, California: System Development Corporation, 9 November 1965.
- Homans, George. Social Behavior: Its Elementary Forms. New York: Harcourt, Brace and World, 1961.
- Simon, Herbert A. Administrative Behavior. New York: Macmillan Co., 1957.
- _____. Models of Man: Social and Rational. New York: John Wiley and Sons, 1957.

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