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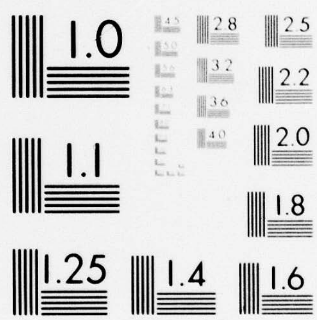

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RESEARCH REPORT

A Criterion Validation of Multiattribute Utility Analysis and of a Group Communication Strategy

Lee C. Eils, III
Richard S. John

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SSRI RESEARCH REPORT 78-4

Social Science Research Institute
University of Southern California
Los Angeles, California 90007
(213) 741-6955

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Summary

This study investigates the use of an external criterion for validating additive utility assessments under certainty. Utilities were elicited from twenty-four groups via consensus judgment for ten hypothetical applicants for bank credit cards. The research design completely crossed two factors relevant to group utility assessment: (1) using a decomposition (MAUA) procedure or not, and (2) using a formal group communication strategy or not. The quality of each group's utility judgments was defined to be the Pearson product-moment correlation between the group's judged utilities and utilities output from a configural (nonlinear) model used by Security Pacific National Bank in evaluating applicants for Master Charge. Group satisfaction measures were also obtained. The decomposition methodology and the group communication strategy both aided groups in making assessments that are more consistent with those of the bank model, which is based on a systematic collection and interpretation of a large amount of relevant data. Simplified procedures for obtaining weight parameters in the multi-attribute utility analysis yielded better overall utilities than more complicated ratio-estimation techniques.

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FIGURE

Figure 1. Average person product-moment correlations between subjective group evaluations and four different objective criteria.

ACKNOWLEDGMENTS

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DISCLAIMER

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Advance Research Projects Agency or of the United States Government.

TABLES

INTRODUCTION

The difficulties groups encounter in arriving at collective decisions are well recognized in the adage that a camel is the product of a group setting out to build a horse. Research has identified a number of interpersonal factors inhibiting group performance on problem-solving tasks (Hoffman, 1965): pressures toward uniformity (caused either by a priori expectations of unanimity or the threat of majority rule); participation biases (fear of rejection and group reliance on talkative members); personality characteristics of dominant group member unrelated to cognitive ability; concentration of power; and failure to search for problems. Janis (1972) illustrated the problems inherent in overly conformist group behavior with historical data from a number of foreign policy decisions resulting in international fiascoes (e.g., Pearl Harbor, Bay of Pigs). Scrutinizing these group decision-making situations, Janis observed that group outputs are often highly dependent upon needs to have warm feelings of solidarity and consensus. This often leads to inhibition of free expression of ideas and failure to realistically appraise alternative courses of action.

In his extensive review of the group problem-solving literature, Hoffman (1965) noted that "most of the experiments to date have concentrated on identifying the barriers to effective problem solving, rather than on discovering means to stimulate group creativity (p. 127)." A decade later, little had changed. In an excellent review chapter, Hackman and Morris (1975) concluded that although "there is no dearth of small group intervention techniques available...relatively little research has been done to assess the value of such techniques for improving group task effectiveness (pp. 92-93)." In general, small group intervention techniques can be classified as either interpersonal (designed to improve the quality of group members' relationships) or procedure-oriented (providing specific strategies for more effective task performance). Based on rather skimpy research, Hackman and Morris (1975) asserted that "interpersonal interventions are powerful in changing patterns of behavior in the group--but that task effectiveness is rarely enhanced (and often suffers) as a consequence," whereas procedure-oriented interventions "often may be helpful in improving effectiveness of the task immediately at hand, but rarely can they be incorporated readily into the ongoing process of the group (Hackman & Morris, 1975, p. 93)." If Hackman and Morris are correct, the obvious next step is to develop and test interpersonal and procedural techniques in concert with one another.

We studied the independent and combined effects of two normative interventions, one interpersonal and one procedural, on the performance of ad hoc three-person laboratory groups. The interpersonal technique was that of a group communication strategy first proposed by Hall and Watson (1971). The procedural technique employed was that of multi-attribute utility measurement (MAUM) a decision aid developed within the last ten years (Keeney & Raiffa, 1976). We chose to use a simplified version of MAUM, first proposed by Edwards (1972), called SMART (simple multi-attribute rating technique). (See Edwards, 1977.) A discussion of the theoretical rationale and empirical support for both of these normative interventions follows.

An Interpersonal Intervention: Group Communication Strategy

Several distinct programs of research have attempted to tackle the interpersonal problems inherent in group decision-making. In each case, the primary goal is to help groups reach a consensus decision that optimizes the resources of the group. We will briefly review four of these approaches, concentrating on the communication strategy intervention we tested.

Mathematical aggregation. One way to avoid problems caused by bringing individuals together is not to bring them together. The mathematical aggregation technique ignores the existence of the group identity by treating group preferences as no more than a collection of individual preferences. Although combining individual judgments by some algebraic rule seem straightforward and practically appealing, it is not without difficulities.

Arrow (1951) demonstrated one of the most serious problems for mathematical aggregation in his Nobel-Prize-winning work on social choice. He proved that it is impossible to combine a set of two or more individual preference orderings over three or more alternatives into a group preference ordering that satisfies a reasonable set of assumptions. A good review of Arrow's work, along with a discussion of several attempts to weaken his conclusions (e.g., Fishburn, 1973; Keeney & Kirkwood, 1975; Pattanaik, 1971) is offered by Seaver (Note 1). We tend to agree with Seaver's conclusion that "all of the formal procedures for aggregating individual preferences or utilities into group preferences or utilities have some undesirable traits (Seaver, Note 1, p. 14)."

Restricted interaction. Two of the more popular restricted-interaction procedures are the Delphi method (Dalkey, 1969a), developed by Norman Dalkey, Olaf Helmer, and their associates at the Rand Corporation, and the nominal group technique (Delbecq, Van de Ven, & Gustafson, 1974), developed by Andre Delbecq, Andrew Van de Ven, and their associates at the University of Wisconsin. Both procedures include the following four steps: (1) individual judgment assessment, (2) feedback of all individual judgments to the group, (3) individual reconsideration of judgments, and (4) mathematical aggregation of revised judgments. Individual judgments are made anonymously in the Delphi procedure, publicly in the nominal technique. Also, limited group discussion for purposes of clarification and explanation is allowed after the feedback stage for nominal groups; Delphi groups are allowed no interaction beyond anonymous feedback.

From a practical perspective, allowing limited group interaction is probably more difficult than prohibiting interaction altogether. In addition, Delphi and nominal groups suffer from the already mentioned problems with mathematical aggregation. The empirical research on limited-interaction techniques, reviewed extensively by Seaver (Note 1), provide far from impressive support (e.g., see Dalkey, 1969a, 1969b; Nemiroff, Passmore, & Ford, 1976; Seaver, Note 2).

Social judgment theory. Analysis of interpersonal conflict is a major theme in the programmatic research carried out by Hammon, Brehmer, and their colleagues under the heading of social judgment theory (SJT; Brehmer, 1976; Hammond, 1973; Hammond, Stewart, Brehmer, & Steinmann, 1975). (This social judgment theory is theoretically tied to Brunswick's "lens model" (Hammond, 1966; Slovic & Lichtenstein, 1971) and seems to bear virtually no relationship with the well-known social judgment theory of Sherif and Hovland (1961), related to persuasion and attitude change.) Although SJT was initially concerned with studying the cognitive characteristics of conflict situations (Hammond, Wilkins, & Todd, 1966), recent developments have suggested that SJT analyses of interpersonal conflict might be useful for bringing groups of divergent individuals closer to consensus (Brehmer, 1976). Within the procedure, individuals are presented with choice alternatives for evaluation. After making private evaluations, individual judgments are made public to all group members. The group is then required to reach a consensus judgment via free discussion. By programming the technique for interactive use with a computer, various descriptive statistics inferred from the individual and group judgments can also be used as feedback. Brehmer (1976) summarizes three examples of SJT applications showing that "the cognitive differences could be identified and accounted for" and that "it was possible to resolve conflict by means of cognitive aids developed within social judgment theory (Brehmer, 1976, p. 1001)."

An early experiment by Hammond, Todd, Wilkins, and Mitchell (1966, Study II) demonstrated that the nature of the discussion allowed group members in reaching consensus produced little effect on group policy indices. However, one might suppose that the same interpersonal difficulties cited by Hoffman (1965) might arise in the (unrestricted) discussion phase of the SJT conflict resolution paradigm, thus producing personality biases in the resulting group policy. Unfortunately, "there have been no studies of the effects of personality characteristics on conflict (Brehmer, 1976, p. 998)" Thus, while the social judgment theorists are free from the criticisms linked to mathematical aggregation of individual judgments, they have not avoided the interpersonal issues inherent in groups striving for consensus judgments. Parenthetically, it is interesting to note the commonality of individual judgment feedback, found in both the restricted interaction (Delphi and nominal) and the SJT procedures.

Communication strategy. A communication strategy is simply a set of verbal instructions to the group members about how to discuss and resolve differences optimally. The rationale comes from Hall and Watson (1971), who hypothesized that:

> A normative statement which would break the strain toward convergence and require a consensual resolution of conflicts--while specifying a number of confronting and obstructive behaviors as legitimate and required--would elicit and sustain a group process which, irrespective of member attitude, would allow untrained groups to function more effectively than they normally would under the normative system which they themselves would bring to the enterprise (pp. 301-302).

The exact set of six guidelines proposed and tested by Hall and Watson (1971) are listed in the Appendix. Briefly, they instruct group members to (1) avoid arguing, (2) avoid "win-lose" statements, (3) avoid changing their opinions only in order to avoid conflict and to reach agreement and harmony, (4) avoid conflict-reducing techniques such as the majority vote, averaging, bargaining, coin-flipping, (5) view differences of opinion as both natural and helpful rather than a hindrance in decision-making, and (6) view initial agreement as suspect.

Several direct tests of the communication strategy proposed by Hall and Watson (1971) have been made. Using middle- and upper-level management personnel from several small businesses, Hall and Watson (1971) demonstrated markedly superior performance for groups employing their communication strategy. The task was the "NASA moon survival problem", which requires subjects to rank order fifteen items of equipment in terms of their importance for survival (see Hall, 1963). An expert solution to the problem has been obtained from the Crew Equipment Research Section of the NASA Manned Spacecraft Center in Houston, Texas. The expert ordering thus provides a criterion measure of performance against which group responses may be compared and evaluated. Hall and Watson (1971) found significant increments in communication strategy groups' performance in terms of group error score and gain over the average group member's response. Of most interest is the finding that 75% of the communication strategy groups realized the assemby effect bonus (i.e., group prediction more accurate than the individual decision of the group's most accurate member), compared to only 25% for the control group.

Nemiroff and King (1975) replicated this finding with college undergraduates. Using only a slightly modified version of the Hall and Watson (1971) communication strategy, they obtained the same gains in performance on the moon survival problem for groups exposed to the normative interpersonal intervention. For their study, over twice as many communication strategy groups as control groups (72% vs. 33%) achieved the assembly effect bonus. In yet another replication, Nemiroff et. al. (1976) compared the Hall and Watson communication strategy, in its pure form, to both the nominal group technique (Delbecq et al., 1974) and a control group. The task employed was the "lost at sea" problem (Nemiroff & Passmore, 1975), similar to the moon survival problem. Undergraduate students enrolled in an organizational behavior class were required to rank a set of fifteen items in the order of importance to survival at sea. An objectively correct rank-ordering, supplied by officers of the United States Merchant Marines, was used as the standard of performance. The communication strategy groups significantly outperformed the other two groups in terms of absolute error score, as well as in gain over the average group member's error score. No differences were obtained between the nominal and conventional process groups. Finally, although half (50%) of the communication strategy groups achieved the assembly effect bonus, only 33% and 8% of the nominal and conventional groups did so, respectively.

Using a similar communication training technique developed by Blake and Mouton (1962), Hall and Williams (1970) found significant differences in performance between trained and untrained groups of college students (undergraduate psychology students), management personnel recruited from industry (ranging from foreman to president), and psychiatric patients (ranging from anxiety reactions to personality disorders). The problem task for the groups was to predict the order in which eleven jurors in the movie "Twelve Angry Men" would change their verdicts from guilty to not guilty (also used by Hall, Mouton, & Blake, 1963, and Hall & Williams, 1966). After observing jurors for 38 minutes of film time, groups made predictions "based on what was to occur in the film, taking all possibilities and reasons into account, rather than on the validity or accuracy of the author's reasoning in developing his characters (Hall & Williams, 1970, p. 46)." Thus, the true order in which the jurors eventually changed their verdicts constitutes a criterion against which to measure group orderings. Groups using the communication strategy developed by Blake and Mouton (1962) obtained lower error scores and realized a larger gain in performance over the average individual response. In addition, half (50%) of the communication strategy groups realized the assembly effect bonus, while only 13% of the control group did so.

These studies by Hall and his associates and Nemiroff and his associates yield strong empirical evidence supporting the communication strategy approach to interpersonal problems. Based on the excellent findings from these four studies, we believe that Hackman and Morris's (1975) negative conclusions regarding the effects of interpersonal intervention techniques on group product may have been somewhat premature. At the least, Hall and Nemiroff's findings provide a happy exception to the rule.

A Procedure-Oriented Intervention: MAUM

Multi-attribute utility theory and measurement is a recent extension of modern utility theory as it developed from the landmark work of von Neumann and Morgenstern (1944). (For good reviews of MAUM, see Fishburn, 1977; Huber, 1974; MacCrimmon, 1973; von Winterfeldt & Fischer, 1975; Fischer, Note 3; Fischer, Edwards, & Kelly, Note 4.) MAUM provides a decomposed evaluation procedure as a means of improving upon the intuitive decision-making process. Decomposition methods divide the overall evaluation task into a set of simpler sub-tasks, each of which is within the judgmental capacities of the decision-maker. Our application of MAUM to the group-decision problem requires that group members express their judgments collectively as if they were functioning as a single decision-maker employing the formal analysis.

Applications of multi-attribute utility measurement typically involve the following steps: (1) an initial listing of the set of alternative courses of action to be evaluated, (2) specification of a set of attributes with respect to which each alternative can be evaluated, (3) numerical assessment of the value of each alternative with respect to each attribute, (4) rank-ordering and ratio-scaling of each attribute in terms of importance, and (5) employment of an arithmetic evaluation rule (a model) to determine the overall value of each alternative.

Multi-dimensional value assessment and multi-attribute utility analysis have been criticized on the grounds that the use of a mathematical combination rule (either additive or multiplicative) ignores configural interaction between the attributes of the outcomes being considered and that these interactions are, in fact, taken into consideration by decision makers at an intuitive level. Major research efforts (Slovic & Lichtenstein, 1971) have greatly weakened this objection by demonstrating that holistic or intuitive judgments can be very well approximated by even a simple additive model.

Research also supports the notion that simply providing more structure in the group process of determining preferences will reduce disagreement among the members of the groups. Gardiner and Edwards (1975) found that less disagreement among two groups of land management planners (conservationists and developers) occurred when a highly-structured multi-attribute utility procedure was employed to determine preference than when simple holistic (unaided, intuitive) judgments were elicited from the group. Subsequent research by Gardiner and Ford (in press) replicates this original finding and lends support to the notion that these procedures not only reduce disagreement, but also help the group focus on the exact points of disagreement, which can then be considered specifically.

The most common approach to utility validation has been to measure convergent validity, or the degree to which different model forms and elicitation procedures correspond to one another. Correlations among a variety of models (risky and riskless, multiplicative and additive) and assessment techniques (holistic and decomposed) have been found to consistently range in the high .80's and .90's (Fischer, 1976, 1977; von Winterfeldt & Edwards, Note 5). Subtle differences have been uncovered using more sensitive techniques of analysis, however. Fischer's (1976) conjoint measurement analysis revealed marked violations of independence assumptions not discovered through correlational analysis. Consistent violations of attribute independence leading to multi-attribute risk aversion are reported by von Winterfeldt (Note 6). On the whole, however, few serious discrepancies among model forms and elicitation procedures have been discovered (Fischer et al., Note 4).

METHOD

Overview

In order to explore the effects of two normative interventions on group decision behavior, a complex and realistic decision-making task was chosen. The task required each group to evaluate the worth (to Security Pacific National Bank) of ten applicants for revolving credit loans made via the bank-issued credit and Master Charge. This task was chosen because it provided several independent criteria against which to validate each group decision. Each of 24 groups (drawn from two university populations) employed one of four experimental procedures (created by completely crossing two normative interventions) in evaluating the ten applicants. Upon completion of the task, individual reactions to various aspects of the group's experience were obtained via a set of seven-interval semantic-differential scales.

Subjects

Graduate students and upper-division undergraduates enrolled at the University of California, Los Angeles, and the University of Southern California were solicited to participate in the experiment. Each was told that the study would involve an exercise in group decision-making which might provide experience valuable in future professional settings; however, no direct compensation was offered. Seventy-two subjects volunteered to participate in groups of three. All subjects within each group were acquainted. None of the subjects indicated any specific knowledge of the credit evaluation process.

Procedure

Each of the twenty-four groups met once with the experimenter in quiet locations for time periods ranging from one to three hours, depending upon the speed at which the group worked. All twenty-four groups were given two decision tasks, each of which required the group to make a consensus judgment regarding the relative values of the choice alternatives provided. The first problem, which involved seven hypothetical apartments identified on three dimensions of worth (monthly rent, distance from work, and quality of neighborhood), was used as warm-up exercise to familiarize the subjects with the task, assessment instrumentation, and experimental setting. Although data were collected for this portion of the experiment, no analyses were conducted and no further reference to the task will appear.

The alternatives for the second task consisted of ten applicants for a bank charge card, each of which was described on ten dimensions:

1. Credit rating and verification thereof
2. Age
3. Employment type
4. Estimated spendable funds per month
5. Industry category
6. Level of education
7. Marital status
8. Whether the applicant owns or rents living quarters, holds an oil company credit card, and has a telephone
9. Number of years at current address
10. Number of years on present job

An example of one the ten alternative applicant descriptions follows:

APPLICANT B

Applicant B is 57 years old and has an excellent credit rating with complete information adequately verified. The applicant has 13 - 15 years of education and is a hospital assistant for a nursing service. The applicant has estimated spendable funds of $261.00 per month, is divorced, has lived at his current address for six years and has held his present position for nine years. Applicant B rents an apartment and has a telephone and major oil company credit card.

Groups were required to assign a number to each applicant reflecting that applicant's value to the bank as a charge card holder.

Utility Assessment

Twelve groups made holistic assessments of applicant worth and twelve performed a decomposed assessment, similar to Edwards' (1977) SMART (Simple Multi-Attribute Rating Technique) procedure. Holistic groups were required simply to rank-order the ten applicants in terms of their desirability as cardholders to the bank. In addition, holistic groups made a dollar estimate of the credit limits to be assigned to each applicant. These credit limits (constrained to the interval $500 to $3500, as in the criterion bank model) constituted the holistic groups' utility assessment of the choice alternatives.

Decomposed assessments were completed in two parts. First, groups assessed the worth of each of the ten applicants on each of the ten dimensions of importance. Using a scale anchored at the two endpoints (0 = worst applicant on dimension and 100 = best applicant on dimension), groups produced one hundred "location measures", $\underline{u}_{ij}$, $(1 \leq \underline{i}, \underline{j} \leq 10)$, representing the value of the $\underline{i}$th applicant on the $\underline{j}$th dimension.

During the second half of the decomposition assessment procedure, an importance weight for each dimension was determined. First, each group rank-ordered the ten dimensions upon which the applicants were described from the most important (= 10) to the least important (=1). Next, the group assigned weights, $\underline{w}_j'$ $(1 \leq \underline{j} \leq 10)$, representing the relative importance of the $\underline{j}$th attribute. Weights were elicited via a standard ratio scaling technique, whereby the least important dimension is first assigned a weight of 10 and the others are assigned weights so that the ratio of any pair of weights represents the number of times more important one dimension is than another. The elicited ratio weights were then normalized to sum to one, i.e., $\underline{w}_j = \underline{w}_j' / \sum_{j=1}^{10} \underline{w}_j'$. Additionally, each group was asked to group the ten attributes into four categories:

0 - Not at all important

1 - Little importance

2 -Moderate importance

3 -Highly important

The number assigned to each attribute (0-3) was recorded as a "rating" of the importance of that dimension. Thus, three sets of empirical weights were elicited: (1) rank weights, (2) ratio weights, and (3) rate weights.

The overall utility of the ith applicant is determined by aggregating the location measures and one of the weight vectors. (Alternatively, one could ignore all three sets of empirical weights and simply assume equal weighting i.e. $w_j = 1$, $1 \leq j \leq 10$.) One aggregation rule is a simple weighted sum across the ten dimensions: Utility of the ith applicant $= U_i = \sum_{j=1}^{10} w_j u_{ij}$. Previous research (cited above) suggests that the additive rule is a good approximation to more complicated function forms, even when the necessary assumptions of utility independence are not met. Thus, our analysis is restricted to the additive aggregation, as assumed in the SMART procedure (Edwards, 1977).

Communication Strategy

Six of the holistic groups and six of the decomposition groups were given the group communication strategy adapted from Hall and Watson (1971, p. 304). The communication strategy, as described above, consists of six statements outlining suggested policies for efficiently dealing with the group interaction situation (see Appendix). Groups were trained in the communication strategy for approximately fifteen minutes. The text of the appendix was read aloud to the entire group, and questions were then answered. A large poster display of the communication strategy was present throughout the group interaction.

The remaining twelve groups were given no additional instructions regarding the decision task.

Post-Decision Measures

Immediately following completion of the group decision task, each subject responded to a set of eight semantic differential scales concerning various subjective impressions of the group interaction. On a seven-point scale, subjects indicated their perceptions of the difficulty and complexity of the decision task, their satisfaction with the decision-making technique, and their commitment to the group decision. In addition, subjects rated the frequency with which group discussion involved the repetition of ideas and suggestions, the frequency with which each person was able to speak, the frequency with which voices were raised in group discussion, and the extent to which group discussion centered around or resulted from direction by one person.

Bank Model

The ten applicants were selected from a sample of 8000 charge card applicants whose files (names, address, and other identifying information withheld) were obtained from a major California bank. The bank has developed a complex mathematical model to evaluate applicants for charge cards, based on information obtained from a standard application form. These bank model scores constituted an "objective" criterion of worth, against which subjective assessments may be compared.

Historically, the existing bank model was developed in two stages. Initially, applicants were assigned a score which was a linear function, the main component of which was disposable monthly income. Applicants received specific credit limits based upon their obtained scored (termed the "RRA score"). Subsequently, a second component was incorporated into the model and has the effect of adjusting the original score up or down as a function of the applicant's "financial stability". An applicant may be rejected altogether if the so called "stability score" is below a certain minimum. The stability score is the product of a specially developed discriminant function designed to separate potentially profitable accounts from unprofitable ones.

The discriminant function was the result of a discriminant analysis carried out on a sample of 4000 good accounts and 4000 bad accounts booked by the bank between 1970 and 1972. The combined scoring rule yields a number between $500.00 and $3500.00, which constitutes the recommended credit limit to be granted the applicant. It should be noted that, in certain cases, the applicant is rejected outright on the basis of individual attributes, regardless of obtained stability score or the number reached by the overall scoring system. Details of the unique non-linear combination of the two components of the bank's decision model (RRA score adjusted quadratically according to the discriminant function stability score) may be found in Rabin (Note 7).

In addition to the bank model information about each applicant, the actual line amounts granted were also known. In many cases, the line amount granted was not the same as the amount suggested by the bank model, as the bank allows its officers to override the model's resulting score if they wish.

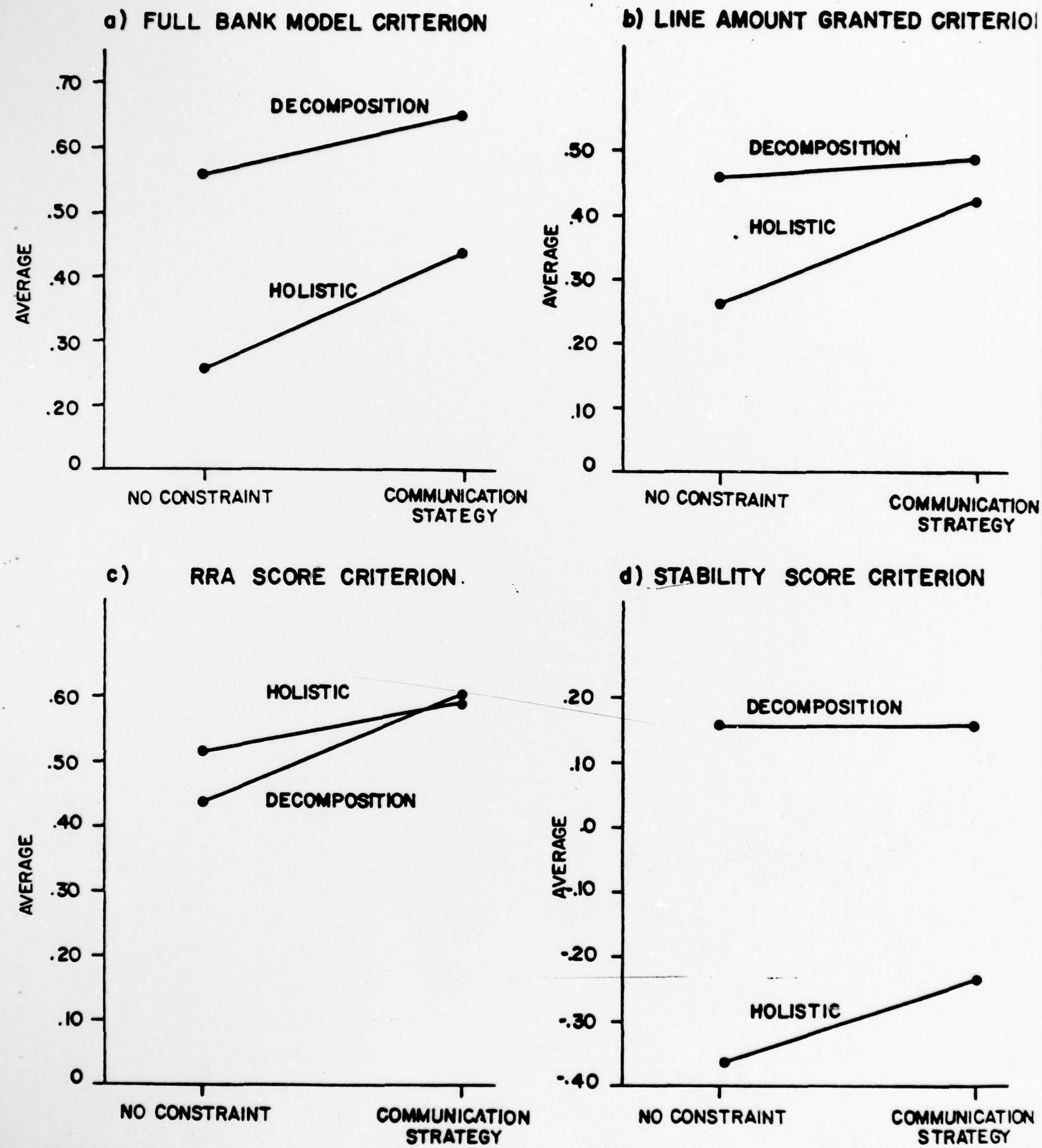
As one would expect, the full bank model correlates moderately well with all of the other criteria (.45, .58, .65). This is natural, since the RRA score and Stability score are combined arithmetically to produce the full model score, and the line amount granted is determined subjectively only after the full model score is known (normally, the line amount granted is the same as that recommended by the full bank model). The other three correlations are not as large, however. Most notably, the stability score is virtually unrelated to the line amount granted (.02) and somewhat negatively related to the RRA score (-.29). The RRA score correlated .37 with the line amount granted. Thus, the four bank criteria constitute somewhat different, though related, meanings of applicants worth.

RESULTS

Quality of Group Decision

Each group's evaluation of the ten applicants was correlated with the four objective criteria: (1) score from the full two-component bank model; (2) actual line amount granted the applicant; (3) "RRA score", first component of bank model; and (4) "Stability score", second component of bank model. Each group-criterion correlation was first transformed to a Fisher _z_ score and averages were computed over the six groups in each cell. These average _z_ scores were then transformed to Pearson correlations using the inverse Fisher _z_ transformation. These average group-criterion correlation, plotted in Figure 1, illustrate the increment in group performance due to use of the decomposition evaluation procedure (ratio weights) and the group communication strategy. The spacing of the decomposition line above the holistic line in three of the four panels indicates a positive effect (at least in direction) for the decomposition methodology. The positive slopes on all eight lines shown in Figure 1 suggest that the group communication strategy was an effective manipulation for improving the quality of group judgments. The near parallelism evident in all four pairs of lines indicates that the effects of the two normative interventions combine additively.

The increment in group performance resulting from use of the SMART procedure was largest for the full-bank-model and stability-score criteria, accounting for 36.4% and 30.1% of the total variance, respectively. A smaller positive effect resulted from the decomposition methodology for the line-amount-granted criterion (11.7% of total variance). A negligible decrement in SMART groups' performance was evidenced for the RRA score


a) FULL BANK MODEL CRITERION
DECOMPOSITION
HOLISTIC
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.50
.40
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.20
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NO CONSTRAINT
COMMUNICATION STATEGY
b) LINE AMOUNT GRANTED CRITERIO
DECOMPOSITION
HOLISTIC
AVERAGE
.50
.40
.30
.20
.10
0
NO CONSTRAINT
COMMUNICATION STRATEGY
c) RRA SCORE CRITERION.
HOLISTIC
DECOMPOSITION
AVERAGE
.60
.50
.40
.30
.20
.10
0
NO CONSTRAINT
COMMUNICATION STRATEGY
d) STABILITY SCORE CRITERION
DECOMPOSITION
HOLISTIC
AVERAGE
.20
.10
.0
-.10
-.20
-.30
-.40
NO CONSTRAINT
COMMUNICATION STRATEGY

criterion (accounting for 0.4% of total variance).[1]

Although the group communication strategy manipulation improved group performance for all four criteria, the proportion of total variance accounted for is considerably less than that attributable to the decomposition methodology. Performance was influenced most greatly for the full-bank-model criterion (10.3% of total variance). Positive communication strategy effects were evidenced to a smaller extent for the line amount granted (6.8% of total variance) and RRA score (5.7% of total variance) criteria. The effect was of little moment for the stability score criterion (0.7% of total variance).

The beneficial influence of the two normative interventions was almost entirely additive for all four of the criteria. Interaction effects accounted for 3.5% of the total variance for the line amount granted, 1.0% for the RRA score, 0.7% for the stability score, and 0.5% for the full bank model criteria.[2]

Overall, SMART groups' evaluations corresponded closely to three of the four objective criteria. In order from greatest correspondence to least are full bank model, RRA score, line amount granted, and Stability score. Holistic groups, however, showed good correspondence only upon the RRA score criterion, followed by the full bank model and line amount granted. A negative relationship was observed between holistic applicant evaluations and the stability scores. One might predict that the holistic groups would fare substantially better on the line amount granted than for the other less subjective criteria, due to the subjectivity inherent in the line amount granted; such was not the case.

Weighting Schemes for SMART Groups

Composite utilities were computed for each of the ten applicants using the four different sets of weights collected from each of the twelve groups employing the decomposition methodology. Correlations were first computed over the ten applicant evaluations for each pair of weighting schemes. Average correlations between weighting schemes were then computed across the twelve SMART groups, utilizing the Fisher $\underline{z}$ transformation procedure outlined above. These correlations are presented in Table 1.
There is a high degree of convergence in the applicant evaluations across the four different weighting schemes, ranging from a low of .69 between ratio and unit weighting to a high of .98 between rate and rank weighting. Rate and rank weights constituted a compromise between the extremeness of ratio weighting (each correlating .90) and the uniformity of unit weighting (correlating .87 and .93, respectively).

Although convergent validity of weighting schemes would seem desirable, the more important question involves the issue of criterion validity. Which weighting scheme creates composite applicant evaluations which are most like those found in the objective bank criteria? To answer this question, each of the sets of applicant composite utilities created from the four weighting schemes were correlated with each of the four objective criteria. Average correlations between each weighting scheme and each objective criterion were then computed across the twelve SMART groups, again applying the Fisher $\underline{z}$ transformation procedure.

Table 1: Average Pearson Product-Moment Correlations Among Four Different Weighting Procedures.

	Ratio	Unit	Rate	Rank
Ratio		.69	.90	.90
Unit			.87	.93
Rate				.98

The resulting four-by-four matrix for average correlations are presented in Table 2. It should be noted that the average correlations in the first column are the same as those plotted in Figure 1 for the decomposition groups, collapsed across the communication strategy manipulation. Further support for convergence among weighting schemes is apparent. The rank-ordering of group-criterion correlations for the three alternate weighting procedures is almost the same as that observed for ratio weighting, i.e., from highest correspondence to lowest, full bank model, RRA score, line amount granted, and stability score. The single exception is the reversal of line amount granted (.47) and stability score (.49) for unit weighting.

The most important result in Table 2, however, is the dominance of the ratio-weighting method by the three simpler alternatives. Rate and rank weighting both completely dominate ratio weighting on all four of the objective criteria. Unit weighting shows even stronger dominance for the full-bank-model and stability-score criteria, equivalence for the line-amount-granted criterion, and slight inferiority for the RRA-score criterion. Little distinction is apparent among the three simplified alternative weighting schemes. Rate weights achieve the highest average correlations for the RRA-score and line-amount-granted criteria, whereas unit weighting delivers the highest correlations observed for stability-score and the full-bank-model criteria. Clearly, the increment in performance due to the use of the decomposition method would be amplified by the use of any of the simplified weighting schemes in place of ratio weighting.

Table 2: Average Pearson Product-Moment Correlations Between Weighting Schemes and Objective Bank Criteria

	Ratio	Unit	Rate	Rank
RRA score	.53	.49	.58	.56
Stability score	.16	.49	.27	.36
Full bank model	.60	.80	.76	.79
Line amount granted	.47	.47	.50	.49

Inter-Attribute and Attribute-Model Correlation

In trying to understand the superior performance of unit, rate, and rank weights to ratio weights, it is useful to inspect the intercorrelations among the ten attributes along which the applicants were described and those between each attribute and some criterion measure. Using the location measures produced for each applicant on each dimension by the SMART groups and the applicant scores on the full bank model, such a correlaion matrix was produced for each of the twelve decomposition groups.

As one would suspect from the high correlations reported among the various weighting schemes, there is a scarcity of large negative inter-correlations (see Newman, 1978). The worst is only -.83, and there are only four which are less than or equal to -.70; the median attribute intercorrelation is .01. However, the presence of some negative inter-correlations was enough to produce the differential degrees of correspondence across weighting schemes shown in Table 2.

The attribute-criterion correlation indicated that SMART groups could have obtained substantially better correspondence to the full bank model by simply weighting either "marital status" (r =.70) or "owns, rent/oil company credit card/telephone" (r =.81) positively and all other dimensions zero. This revelation suggests that the group weights were all poorly estimated. The superiority of the simplified weights is probably due to the flattening of the distribution of ratio weights which might be expected to result from the implementation of unit, rate, or rank weights. In other words, the groups' lack of knowledge concerning good importance weights was less of a hindrance for them in the simplified weighting schemes than in ratio weighting. Obtaining less information is not only simpler, it is safer if the group has little or no information to provide.

Post-Experiment Questions

Each response to the eight semantic differential scales was scored as an integer between 1 and 7, inclusive. A standard 2 x 2 analysis of variance was carried out on each of the eight scales to determine the proportions of total variance explained by the various difference among marginal cell means.

The main benefit of the SMART procedure seems to be in less perceived repetition of ideas and suggestions (7.29% of total variance) and less frequent raising of voices in the group (4.00% of total variance). Its implementation does not seem to greatly affect the perceived complexity or difficulty of the task, the satisfaction with the technique, the commitment to the decision product, the degree to which each person is allowed to speak, or the extent to which an individual dominates the group discussion (all less than 2.00% of the total variance).

The group communication strategy tended to reduce the subjects' perceived level of task complexity (3.24% of total variance) and task difficulty (9.00% of total variance). Virtually no effect was created by the communication strategy for satisfaction with the technique, commitment to the decision product, the degree to which each person is allowed to speak, the extent to which an individual dominates the group discussion,the extent to which ideas and suggestion are repeated, or the frequency with which voices are raised (all less than 2.00% of the total variance).

DISCUSSION AND CONCLUSIONS

Results indicate that use of the SMART decision technology significantly improved the quality of collective decisions, as did, to a lesser extent, the communication strategy. The correspondence between the bank criteria and group decisions reached via the decomposition methodology was improved when the ten attribute weights were obtained from the simplified assessment schemes of rating, ranking, or setting all equal to a constant. The reported findings provide substantial empirical justification for the two normative procedures investigated. These results constitute strong evidence for the argument advanced by Edwards (1977) in support of decomposed methods of evaluating complex choice entities.

The bank's formalized process of evaluating the applicants for revolving credit loans reflects, with some degree of accuracy, the nature of the complex relationship between applicant characteristics and subsequent loan performance. Information bearing on this complex relationship is a part of individuals' past experience (otherwise the choice entities would appear equally attractive and evaluation would be impossible). Thus, the degree to which group decisions correspond to the bank's systematic and complex evaluation provides a measure of the match between the collective decision elicited and group members' experience. It is argued that the advanced behavioral technologies explored by this research are valid in the sense that they elicit a more nearly complete representation of individuals' past experience.

While multi-attribute utility analysis (SMART) was developed for use by individuals, these experimental results suggest that the technique is readily adaptable to the group-task setting. The success of the group decision technology lies in its ability to focus attention to individual value-relevant factors. As reflected by the improved correlations obtained with simplified weighting schemes, the precise specification of weight parameters is of little importance (at least for the task investigated). In the reported study, the assessment of ratio weights merely exhausted group time and energy, while lowering the quality of the decision product.

The success of the group communic tion strategy stems from its diversion of group attention away from interaction not pertaining to past experience relevant to the choice task. The group communication strategy was designed expressly for groups making unaided intuitive judgments in complex decisions. The effect of the strategy renders it a potentially useful approach. An obvious implication of this finding is the need for further development of the communication strategy for use in concert with analytic decision technologies.

Further research for the purpose of developing group multi-attribute utility analysis ought to explore the behavioral effects of simplified weighting schemes. Although a plethora of research exits on the mathematical characteristics of "equal weights" (Einhorn & Hogarth, 1975; Laughlin, 1978; McClelland, in press; Wainer, 1976, 1978), there is no study which explores the psychological effects on individuals or the group as a whole. More complicated assessment procedures, particularly for estimating weight parameters, may not provide better overall utilities. However, there may be some advantage in their use as a technique to aid the decision-maker(s) in thinking hard about the choice problem. Further insight into the decision situation may lead to a revision of the list of attributes of importance or an addition to the specified set of choice alternatives. Such research should, of course,draw heavily upon well-known findings in the area of psychophysics concerning various response modes and elicitation techniques.

For those situations where some weight assessment is preferred, what should be the order of assessment of individual attribute values and importance weights? Although Edwards (1977) suggests that weight assessment precede single attribute utility assessment, good results were obtained in the present study using the reverse ordering. Surely, the decision-maker should be made familiar with the distribution of alternatives over dimensions before he is probed for information concerning the differential importance of those dimensions. As pointed out by Otway and Edwards (Note 8), the set of choice alternatives may not be known prior to utility assessment. In such cases, they recommend that assessed weights be mathematically transformed as a function of the set of real alternatives actually present. Although the idea certainly deserves further investigation, other formal weight transformations should also be considered. In particular, attention should focus upon obtaining a transformation which is sensitive not only to changes in the expected range of the distribution of alternatives over attributes, but also to changes in mean and variance of the distributions.

Although the normative interventions employed were well received by the laboratory decision-making groups, research that explores user attitudes over a variety of complex decision settings is needed. What effect does expertise have on group use of a communication strategy or a decomposition decision technology such as SMART? Perhaps experts combine information in a way that is not adaptable to the formal mathematical structure imposed by multi-attribute utility analysis. Is the communication process of an established group in an organizational setting so unique that a group communication strategy would become ineffective? Clearly, adaptation of normative interventions for use in major decision-making situations must be mediated by concern for group member expertise and organizational constraint.

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Footnotes

1. The univariate hypothesis tests for the SMART effect revealed the following: Full bank model, $\underline{F}_{1,20} = 13.79$, $\underline{p} < .01$; Stability score, $\underline{F}_{1,20} = 8.77$, $\underline{p} < .01$; Line amount granted, $\underline{F}_{1,20} = 3.00$, $\underline{p} > .01$; RRA score, $\underline{F}_{1,20} < 1.00$. The multivariate hypothesis test resulted in an overall $\underline{F}$ statistic of 5.19 with 1 and 17 degrees of freedom, $\underline{p} < .01$.
2. None of the univariate or multivariate hypothesis tests for the group communication strategy or the interaction effect were statistically significant for $\alpha = .01$.

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This study investigates the use of an external criterion for validating additive utility assessments under certainty. Utilities were elicited from twenty-four groups via consensus judgment for ten hypothetical applicants for bank credit cards. The research design completely crossed two factors relevant to group utility assessment: (1) using a decomposition (MAUA) procedure or not, and (2) using a formal group communication strategy or not. The quality of each group's utility judgments was defined

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to be the Pearson produce-moment correlation between the group's judged utilities and utilities output from a configural (nonlinear) model used by Security Pacific National Bank in evaluating applicants for Master Charge. Group satisfaction measures were also obtained. The decomposition methodology and the group communication strategy both aided groups in making assessments that are more consistent with those of the bank model, which is based on a systematic collection and interpretation of a large amount of relevant data. Simplified procedures for obtaining weight parameters in the multi-attribute utility analysis yielded better overall utilities than more complicated ratio-estimation techniques.