RICE UNIVERSITY

THE EFFECTS OF FEEDBACK AND METHOD OF ELICITING SUBJECTIVE WEIGHTS ON THE DECISION PROCESS

by

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A widely accepted finding in the area of decision research is that decision makers are not aware of how they make decisions. The present study re-evaluates this conclusion from two methodological perspectives: (1) the data analysis techniques used in decision research and (2) the methods used to elicit decision makers' descriptions of their decision process. The paper cites evidence suggesting that the results of previous studies which conclude that decision makers are not aware of their decision strategies are highly dependent upon the data analysis techniques employed. Also, the results of the present study demonstrate that eliciting subjective weights using slope related questions produce more accurate decision models than eliciting subjective weights using the traditional 100 points method. The present study also investigates the effect that process feedback has on decreasing the discrepancy between decision makers' subjective and statistical decision strategies. It was found that process feedback had a negative effect on the accuracy of decision makers' descriptions of their decision strategies. An explanation for this finding is presented as well as recommendations for future research.
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INTRODUCTION

A decision maker frequently is called upon to detail his or her decision strategy by describing the effect that certain information had on a decision or the importance a particular factor played in making a judgment. There is evidence, however, that the decision maker's description of his or her own strategy is discrepant from the statistical measure of the strategy. In an early study of this topic, Slovic (1969) asked professional stockbrokers to describe the importance that they placed on each of several information cues when they made decisions. It was found that the importance stockbrokers ascribed to these cues differed considerably from the statistical measure of importance that was calculated for each cue. Although these professionals earned their "expert" status through their ability to interpret and integrate stock market information, the discrepancy between the statistical and subjective descriptions of their decision strategies suggests that they may not have been equally proficient in communicating their decision making expertise to colleagues and students.

Across a variety of decision tasks using various types of decision makers, many studies have reached the same conclusion: decision makers are not aware of how they make decisions. Valenzi and Andrews (1975) compared the perceived and statistical importance of
information cues. They found that while a group of employment interviewers were quite similar in their descriptions of how they weigh information in making employment decisions, the statistical importance calculated for each information cue differed substantially between judges. Zedeck and Kafry (1977) asked nurses to evaluate the performance of hypothetical nurses based upon narrative profiles. The importance that nurses attributed to the various sources of information used in making their evaluations was not consistent with the statistical weights of importance that were derived from their decisions. The majority of studies investigating a decision maker's awareness of his or her decision strategy have reached this same conclusion. Table 1 summarizes these studies and results. As shown, of the ten studies listed, two concluded that decision makers have some insight (Schmitt, 1978; Cook and Stewart, 1975); two concluded that decision makers have at best, marginal insight (Wright, 1979; Permut, 1973); and the remaining six concluded that decision makers have no insight whatsoever into their subjective decision strategy.

The discrepancy between self-described and statistical weights may have important consequences. For instance, Hammond and Brehmer (1973) suggest that discrepancies between how a decision is actually made and how a decision strategy is described is a major
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1. Consensus: The correlation between predictions based upon a subjective or statistical model and actual judgments.
2. Equivalence: The correlation between predictions based upon a statistical model and predictions based upon a subjective model.
3. Effective weights: an index, developed by Aitken (1960), to relate statistical measures to subjective weights.

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source of interpersonal and international conflict. They suggest that the reduction of the discrepancy between actual and perceived decision strategies would decrease conflict. Others have suggested that decreasing the difference between actual and perceived decision strategies would serve to increase the accuracy of expert testimony, facilitate group decision making, and improve the teaching of decision making skills (Slovic, 1969; Hammond, 1971).

Many decision analysts have attempted to remedy the problem of a discrepancy between perceived and statistical weighting strategies by removing the human decision maker from the decision process. Although this practical solution effectively eliminates the problem, it does not provide information regarding the human decision making process. Schmitt and Levine (1977) write that research concerning replacing the human decision maker with a statistical model "might be more appropriate work for the statistician than for the social scientist, for it is the social scientist who is normally more interested in the process of human decision making" (p. 26). For the social scientist, research attention might be more appropriately directed towards studying the decision maker's statistical and perceived strategies in an effort to develop procedures to reduce the discrepancy. Also, although the conclusion that decision makers are not aware of how they make decisions appears to be well founded in the literature, it is not
universally accepted (Schmitt and Levine, 1977; Cook and Stewart, 1975). A review of the studies in Table 1 suggests that the method of data analysis used in the research has a notable impact on the findings. For example, two of the three studies that compared predictions based on objective and subjective weights report that the statistical and subjective strategies are comparable. These results contradict the conclusions of studies using the individual cue weight comparisons.

The purposes of the present paper are (1) to investigate the possibility that the discrepancy between a decision maker's perceived and actual decision strategies depends on the method used to measure discrepancies as well as the method used to elicit subjective weights, and (2) to investigate the effects that process feedback has on the magnitude of these discrepancies.

EFFECTS OF METHODOLOGY

Comparing Statistical and Subjective Weights

Lens Model. A decision can be thought of as the conclusion of an inference process by which available pieces of information, or cues, are evaluated and then aggregated in an attempt to predict some unknown event. Brunswik (1955) observed that the information cues that a decision maker uses in this process are, at best, partial reflections of
the event being predicted. Brunswik developed a lens model to illustrate the simultaneous relationships that information cues have to the event being predicted and to the actual predictions (see Figure 1). In terms of the lens model, a decision maker is perfectly consistent if the strategy he or she uses to aggregate the information cues remains constant across decisions. A decision maker with perfect knowledge is aware of the degree that each piece of information is related to the criterion event.

Measures of cue importance. Defined statistically, consistency is the Multiple Regression coefficient computed by regressing actual decisions on cue values (see Figure 1). Subjective consistency is the correlation of actual decisions with the composite of the cue values weighted by perceived regression weights. The consistency and subjective consistency measures are important since they gauge two distinct facets of a decision maker's performance: the degree to which a decision maker adheres to a single strategy and the degree to which he or she is aware of that strategy. A third measure, correspondence, is an indicator of the extent that the statistical and subjective models yield predictions that are comparable. This index is calculated by correlating the predictions of the regression and subjective models.

Collectively, consistency, subjective consistency, and correspondence provide reasonable comparisons between statistical and sub-
SUBJECTIVE CONSISTENCY

where:

\[ \hat{Y}_s = b_1 x_1 + b_2 x_2 + \ldots + b_n x_n, \]

\( (b_i = \text{raw beta weight for ith cue}); \)

\[ \hat{Y}_I = b^*_1 x_1 + b^*_2 x_2 + \ldots + b^*_n x_n, \]

\( (b^*_i = \text{subjective weight intended for ith cue}); \)

\( x_i = \text{information cues}; \)

\( Y_s = \text{actual decisions}; \)

\( Y_e = \text{criterion event}; \)

\[ r_{Ys} = \text{Subjective Consistency, the correlation between predictions based upon subjective weighting model and actual decisions}; \]

\[ r_{Y\hat{Y}s} = \text{Consistency, the correlation between s s predictions based upon the regression model and actual decisions}; \]

\[ r_{Y\hat{Y}s} = \text{Correspondence, the correlation between s s predictions based upon subjective weights and regression weights.} \]

Figure 1. A representation of the Brunswick Lens Model detailing the comparability of actual decisions and predictions based upon subjective and statistical weighting models.
jective decision models. Against the common criterion of actual decisions, the amount of variance explained by the predictions based on the statistical model can be directly compared to the amount of variance explained by the predictions of the subjective model. If the consistency and subjective consistency measures are approximately equivalent, then the decision maker has adequately described his or her decision strategy. A significant correspondence index indicates that the predictions based on the statistical and subjective models are highly comparable and that the decision maker's description of his or her decision is as representative of the actual decision strategy as the statistical model. An alternative procedure for comparing statistical and subjective decision models is the direct comparison of the statistical and subjective cue weights that are associated with individual cues by either correlating or testing for mean differences between statistical and subjective cue weights. Low correlations or significant mean differences suggest that the decision maker is unable to describe his or her decision strategy.

Decision Maker Awareness

Methods of comparing cue weights. Although it is widely accepted that decision makers are not aware of their decision strategies (Schmitt and Levine, 1977), the degree of awareness that a decision maker is found to have of his or her decision seems to be highly sensitive to the
method of analysis employed by the researcher (see Table 1). Those investigators that compare predictions based upon subjective and statistical models generally conclude that the decision maker has at least a moderate understanding of his or her decision strategy. Researchers that directly compare the subjective and statistical cue weights conclude that decision makers are not aware of their decision strategy. These contradictory findings suggest that the question of a decision maker's awareness of his or her decision strategy is not settled.

The effect that the method of analysis has on the results is demonstrated by a re-analysis of a study reported by Zedeck and Kafry (1977). In the original study, the authors used a t-test procedure to test the significance of the differences between statistical measures of cue importance and subjective descriptions of cue importance. They found that the statistical and subjective weights differed significantly. The re-analysis of the data consisted of calculating a correspondence measure. That is to say, predictions based on the statistical model were correlated with predictions based on the subjective model yielding an index of comparability between the two models (see Appendix 1 for a more complete discussion). The results of this analysis were that predictions based upon the models were quite comparable. This suggests that decision makers do possess some degree of awareness as to how they make decisions. More important, this finding supports the claim that differences found between decision maker
Methods of eliciting subjective weights. The manner in which subjective weights are obtained also may influence the discrepancy between perceived and actual decision strategies. Several techniques have been developed for eliciting quantified descriptions of a decision maker's subjective strategy. The rank ordering of information cues (Valenzi and Andrews, 1973), estimates of probabilities of success (Doherty and Keely, 1972), and wagers using poker chips (Gray, 1979) all have served as expressions of decision maker's subjective strategy. By far, the most widely used procedure is to ask subjects to distribute 100 points in a manner best representing the weight they perceive they gave to each information cue in making a decision (Hoffman, 1960). The points given each cue are then compared to the relative weight of each cue - defined as: \((B_i r_i / R^2) \times 100\), where \(B_i\) is the standardized regression coefficient for the \(i^{th}\) cue, \(r_i\) is the validity coefficient for the \(i^{th}\) cue, and \(R^2\) is the squared multiple correlation coefficient between the cues and the rater's actual decisions. The comparison of the relative weights to subjective weights is done either by correlating the sets of weights for each subject or by computing mean differences for each cue.
Past research comparing techniques of eliciting subjective weights tends to show few differences. For example, Cook and Stewart (1975) compared the 100 point technique for eliciting subjective importance weights with several other procedures which included paired comparisons, estimates of cue importance in terms of a ratio, and variations of the 100 point procedure. The accuracy of predictions based on each of the subjective descriptions were compared with the accuracy of predictions of a Multiple Regression model. All methods for eliciting subjective weights were equivalent and the predictions of the subjective models were comparable to the predictions of the Multiple Regression model.

In a partial replication and extension of the Cook and Stewart (1975) study, Schmitt (1978) compared the several methods of eliciting subjective weights in terms of the accuracy of subjective model predictions. The methods used were the 100 point procedure and the ratio procedure, both studied in the Cook and Stewart study, as well as a new method consisting of rating the importance of individual cues on a 10 point scale. The various subjective models yielded predictions that were virtually identical. In addition to supporting the original findings of Cook and Stewart, the Schmitt study is significant in that it attempted to explore further the possibility that alternate procedures for eliciting subjective weights can be developed.
An alternative method for eliciting subjective weights. The present study explored an improved procedure for eliciting subjective importance measures from decision makers developed on the basis of a recent study by Brehmer and Qvarnstrom (1977). In this study it was concluded that subjects have an intuitive understanding of the concept of weight that corresponds reasonably well with a cue's slope. In a related study, Schmitt, Coyle, and Saari (1977) found that subjects were best able to interpret and use feedback consisting of cue slopes relative to other, more standard types of decision feedback (e.g., outcome feedback, zero order correlations between cues and decisions). These findings suggest that if subjects have an intuitive understanding of the concept of slope and are able to interpret the Beta weight of a cue, then a method for asking subjects to describe their subjective policies using a slope concept might well be effective in eliciting accurate subjective policies. Questions phrased so that the subject is permitted to describe the degree that his or her decisions changed as the cue value increased or decreased permit the decision maker to describe the effect of a cue on a decision rather than describing importance as allowed by current procedures. Additionally, since the subjective weights are estimates of slope, they are more comparable to their statistical counterparts with regard to the underlying meaning of each cue's weight. In the present study, the subjective consistency of predictions based on slope related subjective weights are compared to the predictions using the traditional 100 point weights. It is predic-
ted that the subjective consistency based on the slope weights will be higher than the subjective consistency based on the 100 point weights.

Decision maker awareness is assessed further by comparing the subjective consistency measures to baseline consistency measures derived by applying equal weights to the cue values. These baseline measures, as used in previous research (Cook and Stewart, 1975), serve as a comparison measure of how cues might be weighted in the absence of any information about cue weights. That is to say, if the decision maker were not able to describe the relative weighting pattern he attached to cues, the equal weight strategy might do as well, or better, than a subjective weight strategy in accounting for actual decision variance. In the present study, it is predicted that the subjective consistency measures will account for more decision variance than will the baseline consistency measures derived using equal weights.

EFFECTS OF FEEDBACK

The Discrepancy Between Statistical and Subjective Weights

Based on the discrepancy between statistical and subjective weights, researchers frequently have concluded that decision makers are
not aware of how they make decisions (Schmitt and Levine, 1977; Slovic and Lichtenstein, 1972). Rather than attempting to improve decision makers' awareness of their decision strategies, research interest has been directed towards studying how statistical decision models could be used in place of decision makers. Although considerable research attention has been directed towards developing statistical models, another action available to the investigator interested in the problem of how to deal with the discrepancy between actual and perceived decision strategies is to train decision makers to be more aware of their decision strategies.

Increasing awareness. There are several reasons why research should not neglect the study of how a decision maker's awareness can be increased. One reason is that statistical decision models are not widely accepted by professional decision makers outside of the laboratory. Decision makers often feel that they have a greater intuitive understanding of the problem than a statistical model could ever capture (Goldberg, 1968; Slovic, 1969). Also, for the numerous unique professional decisions that an individual is faced with daily, the data and time necessary to derive a statistical model are often not available. For these reasons, professional decision makers continue to make decisions without statistical assistance. A practical consideration is that it has been hypothesized that if a decision maker is more aware of how he or she makes decisions, this will increase the decision maker's
control of how information is weighed and aggregated in a decision (Hammond and Summers, 1972). This increased control would be reflected in an increase in decision consistency and reliability.

Outcome feedback. To date, Schmitt's (1978) study of the effects of feedback on the awareness of decision makers is the only research that has focused on the topic of whether or not a decision maker's descriptions of his or her strategy can be improved with decision feedback. In this study, Schmitt investigated the effects of decision feedback on the consistency and subjective consistency of decision makers. The decision task was to predict how well a hypothetical student would do in school based on four information cues: Quantitative Ability, Verbal Ability, Responsibility and Achievement. After making each decision, subjects in the feedback condition received outcome feedback consisting of the correct answer to the prediction task. Providing information regarding how a decision should be made did not increase the decision maker's awareness of how a decision is made. In fact, outcome feedback had a negative effect on both the consistency and the subjective consistency of decision makers.

The negative effect of outcome feedback on consistency has also been obtained by other investigators (Todd and Hammond, 1963; Steinmann, 1974). A frequently cited reason for the negative effects of outcome feedback is that it is confusing to the decision maker (Schmitt, Coyle, and Saari, 1977; Hammond, 1971). With outcome
feedback, no indication is provided regarding the source of the decision maker's errors nor is any information given about what aspects of the decision are correct. It is possible that this problem of confusion also can be cited as a reason that outcome feedback has a negative effect on subjective consistency. Overall, the use of outcome feedback to provide information about any aspect of the decision process does not appear to be appropriate in a complex decision task.

Process feedback. Steinmann (1974) found that providing the decision maker with information regarding how different information cues affect his or her decision improves consistency. Typically, this type of feedback, known as process feedback, provides the decision maker with statistical measures of how important an information cue was in making decisions. Although these statistical measures might not accurately reflect the actual strategy the decision maker believes he or she is using, this feedback does provide a detailed statistical representation of how information was utilized in a decision process. The positive effects of process feedback on consistency suggest that the effects that process feedback has on subjective consistency also should be studied.
The Present Study

The present study investigated the effects that statistical feedback about subject's cue utilization had on the consistency and subjective consistency of decision makers. The feedback provided was the Beta weight associated with each cue. These measures were selected since they have been found to be effective in increasing the consistency of decision makers relative to other statistical indices (Schmitt, Coyle, and Saari, 1978). In that process feedback provides the decision maker with information regarding the process of making a decision (i.e., how cues were utilized in making decisions), it was hypothesized that process feedback would increase the subjective consistency of the decision maker. Also, it was expected that process feedback would have a positive effect on the consistency of decision makers.

In addition, two further questions were studied. First, is the method of eliciting subjective weights related to the discrepancy between subjective and statistical weights? Second, what effects does process feedback have on the discrepancy between subjective and statistical weights?
The specific hypotheses investigated for each of these topics are listed below.

Decision Maker Awareness:

Hypothesis (1) The consistency and subjective consistency indices will be comparable supporting the conclusion that decision makers are aware of their strategies.

Hypothesis (2) The subjective consistency measures will account for a greater degree of actual decision variance than will the baseline consistency measures of equal weights.

Hypothesis (3) The correspondence index will be significantly greater than zero and of substantial magnitude, reflecting the comparability of the predictions of the subjective and statistical models.

Method of Eliciting Subjective Weights:

Hypothesis (4) Higher subjective consistency measures will be found when the slope-related method is used to elicit subjective weights than when the 100 point weights method is used.
Hypothesis (5) Higher correspondence measures will be found when the slope-related method is used to elicit subjective weights than when the 100 points method is used.

Process Feedback:

Hypothesis (6) Subjects receiving process feedback will have higher consistency and subjective consistency measures than subjects receiving no feedback.
**METHOD**

Judgment Task. A personnel selection task was used in this study. Subjects were told that the purpose of the study was to investigate what type of college graduate current college students considered most qualified to take on a management career. After reviewing a description of the management job for which the applicants were being considered (displayed in Appendix 2), subjects evaluated the resumes of hypothetical applicants who supposedly had gone through initial on-campus recruiting interviews. The subjects' specific task was to screen resumes to determine which applicants should be called back for a second, more in-depth interview. The choices on the five-point rating scale ranged from (1) "definitely would not recommend hiring"—with a scale value of one—to (5) "definitely would recommend hiring"—with a scale value of five. The subjects were informed that the names and resumes of the applicants were hypothetical (i.e., these were not real people).

Resumes. The resumes were computer generated printouts bound in booklet form. Although the rating scale was printed at the bottom of each resume, subjects recorded their evaluations on a separate form. Each resume consisted of the applicant's name and five information cues, which are described below:
1. Number of job-related courses: This refers to the number of college courses that both the applicant and the initial interviewer agreed were relevant to the type of work the applicant might go into, such as courses in management, finance, economics, some psychology, etc.

2. Years of job-related experience: This refers to the years of work experience--fulltime, part-time, summer--that both the applicant and the initial interviewer agreed might be relevant to the type of work the applicant might go into, such as work involving bookkeeping, writing, sales, management, etc.

3. Class rank in college: The percentage ranking of the applicant's overall grade point average relative to all other graduates in his or her class.

4. MGAT (Michigan General Aptitude Test): A short, 30-minute standardized aptitude test given to all applicants before the first interview. Scores are reported in terms of the applicant's standing among other college students tested nationwide.

5. Social skills rating from initial interview: On the basis of the first interview, the company representative made an overall rating of the applicant. This rating, from a low of one
(1) to a high of ten (10), reflects the interviewer's impression of the overall, nonacademic side of the applicant. Factors such as presentation style, attitude, maturity, motivation, personal appearance, and social skills all influence this ranking.

The name of the applicant conveyed each applicant's gender. To ensure that this information was not ambiguous, four individuals not participating in the study independently confirmed that the names were traditional male or female names.

The values for each cue were sampled independently from a uniform distribution. Because there were four sets of resumes for each subject to analyze, four separate sets of cues were generated randomly. Appendix 3 displays the intercorrelation matrix for each of the four resume sets.

Subjects. The participants were 30 male and 30 female Rice University undergraduates enrolled in introductory level Psychology courses, such as General Psychology, Child Psychology, and Industrial and Organizational Psychology. Subjects received extra credit for their participation.
Procedure. Subjects were randomly assigned to one of five groups, with the constraint that an equal number of males and females were in each group. The five groups were:

1. **PRACTICE**: Subjects were asked to evaluate four sets of resumes. The number of resumes in each set were 50, 50, 50, 100, presented in that order. Subjects recorded their recommendations on a separate form.

2. **POINTS**: This group's task was identical to the practice group except that at the end of each set of resumes, subjects were asked to distribute 100 points among the cues in a manner that would best reflect the weight they had applied to each cue in making their decisions. The applicant's sex was included among these cues. The actual format of these questions is displayed in Appendix 4.

3. **SLOPE**: This group's task was identical to the practice group except that they were asked to answer several questions about their decisions at the end of each set of resumes. These questions asked subjects to give the slope of each cue in relation to their decisions. The questions took the general form: For every unit change in a cue, you changed your recommendation of the applicant X points, or fractions of a
point. For the question regarding males and females, subjects were asked to estimate how much higher or lower, on the average, they rated males than females. The actual questions are displayed in Appendix 5.

4. FEEDBACK. This group's task was identical to the practice group except that subjects recorded their recommendations by keying them into a computer. The recommendation value they entered was simultaneously displayed on a CRT to avoid input errors. At the end of each set of resumes, subjects were given feedback informing them of how they weighted each cue in the previous set of evaluations. The feedback, displayed on a CRT, was the raw beta weight for each cue. Prior to receiving this information, subjects were required to read an explanation of what was meant by this feedback. Before feedback was shown, subjects were required to key in a "YES" response to the question regarding whether they fully understood the meaning of the feedback. The explanation of feedback given to the subjects is shown in Appendix 6.

5. COMPLETE: The last group was a combination of the slope group and the feedback group. Subjects entered their recommendations directly into the computer. At the end of each set of resumes, each subject keyed into the computer answers
to the identical questions asked of the slope group. After entering these answers, the subject received feedback about his or her actual cue utilization pattern. The statistical weights (raw beta weights) and the subjective weights (answers to slope questions) were simultaneously displayed on the CRT.

All subjects were tested individually with the same experimenter conducting each session. To ensure that each subject was familiar with the range of values for each cue, all groups were given five practice resumes to evaluate prior to the start of the testing session.

The feedback provided to the Feedback and Complete groups was displayed on the CRT for 47 seconds. Pilot subjects reported that this was adequate time for processing the feedback.

RESULTS

For each subject, a consistency measure was calculated in the form of the Multiple Regression coefficient. This was done by regressing actual decisions on cue values for each of the four sets of resumes evaluated. For those subjects providing subjective weights, subjective consistency measures and correspondence measures were
calculated for each of the four sets of resumes. The subjective consistency measure is the correlation of actual decisions with the composite of cue values weighted by the subjective weights. The correspondence measure is the correlation of predictions based upon a Multiple Regression model and predictions based upon the subjectively weighted model. As a baseline measure of consistency, an equal weights consistency measure was calculated for all subjects. This measure is the correlation of actual decisions with the composite of cue values weighted by equal weights. Since groups contained both male and female subjects, all analyses include the sex of the subject as a variable.

**Decision Maker Awareness.** Hypothesis 1 was examined using a 2 (weighting method) x 2 (sex) x 4 (trials) Repeated Measures Analysis of Variance (ANOVA) to compare the consistency and subjective consistency measures for the Slope group and the Points group. A summary of these analyses are presented in Figure 2.

Contrary to the prediction, the consistency measures are higher than the subjective consistency measures. In both the Slope and the Points groups, the statistical model accounts for a greater degree of actual decision variance than does the subjective weight model. For the Slope group, the mean consistency measures $\bar{X}_c = .8742$, was significantly higher than the mean subjective consistency measure, $\bar{X}_{sc} = .8225$, $F(1,10) = 37.68$, $p < .001$. 
Figure 2. A comparison of consistency measures, with and without correcting for shrinkage, to subjective consistency measures.
For the Points group, the mean consistency measure, $X_c = 0.8651$, was significantly higher than the mean subjective consistency measure, $X_{sc} = 0.7651$, $F(1,10) = 22.40, p < .001$. These analyses were repeated after the consistency measures were corrected for shrinkage (Kerlinger and Pedhauzer, 1977). Again, the corrected mean consistency measures were higher than the mean subjective consistency measures.

For the Slope group, the mean corrected consistency measure, $X_{c-adj} = 0.8577$, was significantly higher than the mean subjective consistency measure, $F(1,10) = 14.98, p < .01$. This also was found in the comparison of the mean corrected consistency measure in the Points group, $X_{c-adj} = 0.8470$, to the mean subjective consistency measure for the group, $F(1,10) = 13.40, p < .01$.

Support for Hypothesis 2 was obtained in the comparison of the subjective consistency measures (the correlation of subjective weight predictions with actual decisions) with the baseline consistency measures (the correlation of equal weights predictions with actual decisions). As shown in Figure 3, the equal weights consistency measures were significantly lower than the subjective consistency measures for both the Slope group, $F(1,10) = 28.77, p < .001$ and the Points group, $F(1,10) = 22.15, p < .001$.

Hypothesis 3 was supported. Significant mean correspondence measures (the correlation between predictions of the Multiple Regression model and predictions of the subjective weight model) were found
Figure 3. A comparison of the subjective consistency measures and the equal weights consistency measures.
for the Slope and Points groups. For the Slope group, the mean correspondence measure was .9413 (p < .001). For the Points group, the mean correspondence measure was .8851 (p < .001).

Method of Eliciting Subjective Weights. Hypothesis 4, that the slope-related subjective weights would yield higher subjective consistency measures than would the 100-point weights, was supported. Using a 2 (group) x 2 (sex) x 4 (trials) Repeated Measure ANOVA, it was found that the mean subjective consistency measure for the Slope group, $\bar{X}_s = .8225$, was significantly higher than the mean subjective measure for the Points group, $\bar{X}_p = .7651$, $F(1,20) = 7.49$, $p < .05$.

The prediction that the correspondence measure would be higher for the Slope group than for the Points group (Hypothesis 5) was supported. The mean correspondence measure for the Slope group, $\bar{X}_s = .9413$, was significantly higher than the mean correspondence measure for the Points group, $\bar{X}_p = .8851$, $F(1,20) = 5.09$, $p < .05$.

Regarding the effect of sex on subjective consistency, the mean subjective consistency measure for females ($\bar{X}_f = .8244$) was significantly higher than the mean subjective consistency for males ($\bar{X}_m = .7632$), $F(1,20) = 8.54$, $p < .01$. The interaction of sex and method of eliciting subjective weights was not statistically significant, $F(1,20)$.
= 1.02, \( p > .05 \). A significant Sex x Trials interaction was found, \( F(3,60) = 4.84, p < .01 \), and is displayed in Figure 4. No other effects were statistically significant.

Process Feedback. To assess the effects of process feedback on decision makers' consistency (Hypothesis 6), a 5 (groups) x 2 (sex) x 4 (trials) Repeated Measures ANOVA was performed. It was found that feedback has no effect on consistency. The means for the five groups do not differ significantly, \( F(4,50) = .83, p > .05 \). The means and standards deviations for the consistency measures of group are presented in Table 2.

TABLE 2. Means and standard deviations for the consistency measures for each group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice</td>
<td>.8781</td>
<td>.0435</td>
</tr>
<tr>
<td>Feedback</td>
<td>.8661</td>
<td>.0654</td>
</tr>
<tr>
<td>Slope</td>
<td>.8742</td>
<td>.0478</td>
</tr>
<tr>
<td>Points</td>
<td>.8651</td>
<td>.0748</td>
</tr>
<tr>
<td>Complete</td>
<td>.8475</td>
<td>.0834</td>
</tr>
</tbody>
</table>
Figure 4. The Sex x Trials Interaction for the subjective consistency measures.
There was a significant main effect of trials, $F(3,150) = 7.96, p < .001$. The trial means are displayed in Figure 5. The differences in trial means do not show the increase in consistency over trials that has been found in previous research (e.g., Deane, et al, 1972). A post hoc comparison of trial means, using the Scheffe' method, revealed that the mean consistency measure on the third trial was significantly higher than the mean consistency measure on the other three trials, $F(3,150) = 7.225, p < .01$. These differences include a significant increase in consistency between Trials 3 and 4, $F(3,150) = 6.31, p < .01$, and an increase in consistency between Trials 2 and 3, $F(3,150) = 5.35, p < .01$. The increase in consistency between Trials 1 and 2 was not statistically significant, $F(3,150) = .41, p > .05$.

Regarding the effect of sex on consistency, a significant Group x Sex interaction was found, $F(4,50) = 2.65, p < .05$. A post hoc comparison of means, using the Scheffe' method, revealed that the difference between the mean consistency measures of males and females in the feedback group differed from the mean consistency measures of males and females in the other groups, $F(4,50) = 2.58, p < .05$. Figure 6 displays the means for males and females by group.
Figure 5. Trials effect for the consistency measure.
Figure 6. A comparison of consistency measures for males and females by group.
The effect of process feedback on decision makers' subjective consistency was assessed by comparing this measure for subjects in the Complete group (subjects receiving process feedback and answering slope-related questions) with the same measures for subjects in the Slope group (subjects answering slope-related questions but not receiving feedback). This comparison was made using a 2 (group) x 2 (sex) x 4 (trials) Repeated Measures ANOVA. The mean subjective consistency measure for the Complete group, $\bar{X}_C = .7448$, was significantly lower than the mean subjective consistency measure for the Slope group, $\bar{X}_S = .8225$, $F(1,20) = 4.55$, $p < .05$. There also was a main effect of trials, $F(3,60) = 3.37$, $p < .05$. No other effects were found to be statistically significant.

DISCUSSION

Three important conclusions can be derived from the results of this study. First, decision makers' descriptions of their decision strategies compare reasonably well with statistical descriptions of their decisions. Second, the accuracy with which a decision maker can describe his or her decision strategy is affected by the method used to elicit the subjective model description. Finally, process feedback has a negative effect on subjective consistency measures of decision makers. Each of these conclusions is discussed below.
Decision making awareness. Unlike the majority of studies discussed in the introduction and presented in Table 1, the present study does not support the conclusion that decision makers are unaware of their decision strategies. It was found that the consistency measures, defined as the amount of actual decision variance accounted for by a linear Multiple Regression model, was significantly higher than the amount accounted for by subjective consistency measures, defined as the amount of actual decision variance accounted for by the decision makers' subjective weight model.

The question of whether or not the differences found between the consistency and subjective consistency measures are of any practical significance still needs to be considered. The results of the present study show that the subjective weight descriptions account for an average of 91 percent of the maximum linear variance in actual decisions. After the statistical measures are corrected for shrinkage, the subjective weight descriptions account for 93 percent of the linear decision variance. The high degree of linear variance which can be accounted for by a decision maker's subjective weight strategy indicates that decision makers can describe their decision strategies reasonably well.

The comparison of the subjective consistency measures to the equal weights consistency measures clearly supports the conclusion that decision makers are aware of their decision strategies. Considerably
more actual decision variance was accounted for by the decision model consisting of subjective weights than was accounted for by the baseline decision model comprised of equal weights.

The awareness that decision makers have of their decision strategies is demonstrated further by the high degree of correspondence between the predictions of the subjective and statistical models. The correspondence measures found in this study are quite similar to those found in the reanalysis of the Zedeck and Kafry (1977) data (see Appendix 1). This comparability indicates that the subjective and statistical models can be interchanged in certain circumstances without substantial consequence. The results also indicate that decision makers do possess some degree of awareness of their decision strategies. For this reason, the application of subjective weight models in decision making should be more fully explored. For example, in situations where intuitive decision making is relied upon, it appears reasonable, even preferable, to introduce subjective decision models. Additionally, subjective decision models would be quite appropriate in instances where a sample size is not adequate for the development of a statistical model.

The appropriateness of statistical models in describing decisions and predicting events should not be underestimated. In the present study, the finding was that the statistical model did account
for a greater amount of actual decision variance than did the subjectively weighted model. This was also true after correcting the statistical model for shrinkage. Therefore, the use of statistical models in decision research should remain a major analytical technique. The findings of the present study are most relevant as a demonstration that decision tools are available that lie between statistical models and intuitive judgment.

Method of eliciting subjective weights. The results of this study show that alternative, more sensitive methods of eliciting subjective weights can be developed. The fact that slope related subjective weight questions yielded higher subjective consistency and correspondence measures than did the points subjective weight questions is encouraging. These results substantiate the Brehmer and Qvarnstrom (1977) conclusion that decision makers understand the concept of regression weight in terms of slope. Also, the comparability of the slope model's predictions and the statistical model's predictions indicate that subjects can, in fact, describe their decision strategies more effectively using a slope concept than the more common points technique. In noting differences between the slope and the points methods, it is important to emphasize that the slope and points questions differ with regard to the basic question being asked. The slope questions elicit estimates of how a specific change in a cue value affects a subject's final decision. Points questions ask a subject only to describe the overall importance of cues.
The finding that a decision maker's description of his or her decision is sensitive to the method used to elicit that description is contrary to the conclusions of Cook and Stewart (1975). These different findings can be explained by the fact that while Cook and Stewart compared several methods of eliciting importance descriptions, the present study compared the 100 points importance measures with estimates of cue effects. While various methods of describing overall cue importance may be equivalent, as found by Cook and Stewart, there appear to be substantial differences between measures of cue importance and measures of cue effect. The measure of cue effect, as gauged by the slope questions, provides a better account of actual decision variance than does the points measure of cue importance.

Consistent with previous research (Slovic, 1969) subjects claim that their importance ratings for cues are dependent upon the values of other cues. Although statistical evidence suggests that such interactions are not present (Goldberg, 1968; Slovic, 1969), the use of subjective weight questions as a means for the decision maker to quantify their configural cue use would be of interest. Future research might study how the amount of variance accounted for by a subjective decision model fluctuates when the decision maker is given the opportunity to describe his or her strategy with either an additive or multiplicative model. Slope related subjective weight questions easily could be phrased to elicit these interaction estimates.
Process feedback. The finding that process feedback does not improve consistency is contrary to findings previously reported (Steinmann, 1974). Although other researchers also have found instances where process feedback did not improve consistency, their explanation of this lack of effect was that subjects did not attend to the feedback information (Schmitt, Coyle, and Saari, 1977). This explanation is not totally applicable to the present study since feedback did have a negative effect on decision maker's subjective consistency measures.

An explanation consistent with the findings of the present study is that subjects did attend to the feedback but did not apply the information to their actual decision strategies. The effect of feedback on subjective consistency was the result of the decision makers modifying their strategy descriptions to conform more closely with the feedback information. Consequently, subject remained relatively consistent in actually applying a single decision strategy but their descriptions of their policies were influenced negatively by the process feedback.

One surprising finding in this study is that the consistency measures do not show the increase over trials that would be expected with practice. Two explanations can be made for this finding. First, it is possible that the pronounced decrease in consistency on the fourth trial block is attributable to subjects becoming fatigued or bored with the task. Second, it is possible that since the fourth
trial block contained 100 resumes, twice the number contained in each of the other trial blocks, subjects were unable to maintain their consistency in making that large of a number of ratings. Unfortunately, since only the fourth trial had 100 resumes, the trial order and number of resumes presented are confounded. By design, the increased number of resumes in the final trial block was meant to increase the stability of the statistical importance measures. As a result of this confounding, no clear explanation of the trials effect can be offered.

Sex of the Decision Maker. In the present study, the sex of the decision maker was investigated. Two interesting findings came out of these analyses. First, females were found to have higher subjective consistency measures than males. Second, males and females were found to differ with regard to how each responded to feedback. It was only in the feedback group that the mean consistency measure for males was above the mean consistency measure for females. These findings are difficult to explain. It is possible that they are specific to the decision task that was used in this study (evaluating resumes) and are not generalizable to other decision tasks. Another possible explanation for these findings is that females were more conscientious and attentive subjects in the present experimental setting. (Subjects were required to read several pages of instructions prior to beginning the task.) Since the analysis of the sex of the decision maker was
exploratory, generalization of these findings should be guarded. What is important to note is that differences may exist between males and females in decision making tasks.

CONCLUSION

The results of the present study show that decision makers are aware of their decision strategies and can describe those strategies accurately. Further, the findings demonstrate that the method of eliciting subjective weights effects the accuracy of decision makers' descriptions. Accuracy, in the present study, is gauged by (1) the comparability of the amounts of actual decision variance accounted for by the subjective weight model and the statistical model and (2) the degree of correspondence between the predictions of the subjective weight model and the statistical model. The effects of feedback on consistency and subjective consistency indicate that while the feedback did not influence subjects' consistency in making actual decisions, it did negatively effect the subjective consistency of their policy descriptions.

These results support the conclusion that decision makers do have at least some understanding of their decision strategies. Also, the finding that methods of eliciting subjective weights do differ
re-establishes the possibility that more sensitive subjective weight measures can be collected by refining the questioning techniques. The feedback results of this study strongly indicate that statistical process feedback is not the method to use to improve a decision maker's awareness of his or her decision process. Given the degree of awareness decision makers already possess, the need for feedback at all is questionable. Based on these findings, it is concluded that research is needed in the area of developing new, more sensitive techniques for eliciting subjective weights from decision makers.
Correspondence Analysis

Zedeck and Kafry (1977) tested the hypothesis that decision makers were not aware of their decision strategies by testing the differences between the mean statistical measure of cue importance and the mean subjective measure of cue importance. The statistical measure used was Hoffman's (1960) relative weight index which is a measure of the proportion of linear variance accounted for by each information cue. The subjective measure of importance was derived from the 100 point allocation procedure (Hoffman, 1960). This procedure consists of subjects distributing 100 points among information cues in a manner they feel best reflects the relative importance that each cue had in their decision process. The results of this study were that the subjective statements of importance differed significantly from the statistical measures. The authors conclude that this difference is an indication of the low degree of awareness that decision makers have of their own decision strategies.

The data from the Zedeck and Kafry were reanalyzed and a correspondence measure was calculated. That is to say, predictions based on the statistical model were correlated with predictions based on the subjective model yielding an index of comparability between the two models. To accomplish this, a procedure for comparing predictions
using the decision models was used (Marques, Lane, and Dorfman, 1979). Across subjects, the mean relative weight measures for each cue were converted to Beta weights by multiplying the relative weights by the highest reported $R^2$ and also multiplying each weight by the lowest reported $R^2$. The $R^2$ value is the measure of linear variance accounted for by each subject's statistical decision model. Analyses were done for the highest and lowest $R^2$ measures since, in the absence of $R^2$ measures for each subject, these extreme values represented the range of possible $R^2$ values for subjects in this study. This same procedure was followed for the two independent samples of subjects participating in the study. The findings for the sample of Public Health Nurses were that the correspondence measures were .9319 for $R^2=.41$ and .9399 for $R^2=.77$. For the sample of Registered Nurses, the correspondence measures were .8746 for $R^2=.20$ and .9356 for $R^2=.90$. The correspondence measures for both samples of subjects compare favorably with similar measures reported elsewhere (Summers, Taliaferro, and Fletcher, 1970).
APPENDIX 2

Job Description

This management opportunity represents an entry level position in a nationwide insurance company. We are looking for recent college graduates who are self-motivated and willing to learn the workings of our company's management. During the first year, the new management employee can expect to receive on-the-job training in at least two of the following departments: sales, purchasing, training, industrial relations, personnel, salary administration, and labor relations. There is no standard management trainee program offered. The company offers the recruit the opportunity to get actual work experience and, with this, responsibility. In return, the company expects the individual to learn and develop those skills that he or she might lack at the outset of the job. After one or two years of on-the-job training in several departments, the trainee should then be ready to narrow career interests to a particular department. At this time, the trainee will be assigned a suitable management position in his or her chosen area.

It is the intent of this company to develop management recruits by giving them a broad background in the workings of the various departments. It is because of these demands placed on our
management recruits that we are looking for those applicants who are both willing and able to confront the challenges and handle the responsibilities our recruits must face.

As was mentioned before, your task is to screen applicants before second interviews are given. A low recommendation would indicate that you did not feel an applicant was suited for the type of job and responsibility mentioned above. As your recommendation increased, so would the probability that the applicant would be called in for a second interview.
APPENDIX 3

Intercorrelation Matrix For Each of the Four Resume Sets

GRAND MEAN = .082

<table>
<thead>
<tr>
<th>Set 1.</th>
<th>N = 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
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<td>Courses</td>
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<td>Experience</td>
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<td>Social Skills</td>
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<tr>
<td>MGAT</td>
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<tr>
<td>Class Rank</td>
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Mean = .052
SD = .148

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<tr>
<td>Experience</td>
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<td>MGAT</td>
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<td>Class Rank</td>
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Mean = .093
SD = .207

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<td>Social Skills</td>
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<td>MGAT</td>
<td>-.21</td>
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<td>Class Rank</td>
<td>-.06</td>
</tr>
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</table>

Mean = .125
SD = .174
Set 4. \( N = 100 \)

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Courses</th>
<th>Experience</th>
<th>Social Skills</th>
<th>MGAT</th>
<th>Class Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
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<td>-.09</td>
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<td>SD</td>
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<tr>
<td>SD</td>
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</table>

Mean = .057
SD = .158
Points Method for Eliciting Subjective Weights

Making a decision can be thought of as taking separate pieces of information and combining them in some way to arrive at a decision. While one person may think a particular piece of information is the most important factor in a decision, another person may consider that factor irrelevant. Such instances are common since individuals differ in how they weigh each piece of information that goes into their decision.

The following question will help reveal how you, as an individual decision-maker, decided to weigh the pieces of information about each applicant in arriving at your decision. It is important that you try to be as accurate as possible in the description of your decision. As before, your answers will be confidential, so please be honest and straightforward in your responses.

With regard to your recommendations about hiring this most recent set of applicants, please distribute 100 points between the following bits of information which described each applicant. In deciding how to distribute points, compare each factor with the others so as to determine the weight that best reflects the actual strategy.
you used to evaluate the resumes. For example, if you thought one factor was more important to your decision than another factor, then that first factor should receive more points. Be sure that your total points add to 100 and only consider the decisions you've made on the most recent set of applicants.

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex of the applicant:</td>
<td></td>
</tr>
<tr>
<td>Number of job related courses:</td>
<td></td>
</tr>
<tr>
<td>Years of experience:</td>
<td></td>
</tr>
<tr>
<td>Social skills:</td>
<td></td>
</tr>
<tr>
<td>Class rank:</td>
<td></td>
</tr>
<tr>
<td>MGAT score:</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** 100

With all other factors equal, I tended to give males (higher, equal, lower)--circle one--recommendations than females.

**NOTE:** If you circled "lower", please put a negative sign (−) in front of the point value you assigned to the "sex" factor above.
Slope Method for Eliciting Subjective Weights

For each applicant you were asked to make the recommendation you thought was appropriate in view of their qualifications. The following questions are designed to reveal how the characteristics of different applicants influenced your recommendation. These questions try to determine how an individual decision-maker weighs pieces of information in arriving at a decision. If a factor was not important to your decision, then that factor should have had no affect on your recommendation of applicants.

Please read each question carefully and answer as accurately as possible. Answer these questions considering only those decisions you've made on the most recent set of applications.

A. With all other factors equal, I tended to give males (higher, equal, lower)—circle one—recommendations than females. The average difference in recommendation points, or fractions of a point, was approximately ____________ (Note: if you circled "higher," put a positive sign (+) before this value; if you circled "equal," put a zero value; if you circled "lower," put a negative sign (-) before this value.)
B. With all other factors equal, for each job related course an applicant had, I increased my recommendation of the applicant ______ points, or fractions of a point.

C. With all other factors equal, for each year of job related experience an applicant had, I increased my recommendation of the applicant ______ points, or fractions of a point.

D. With all other factors equal, for each point an applicant had in the social skills rating, I increased my recommendation of the applicant ______ points or fractions of a point.

E. With all other factors equal, for every 5 percentage points an applicant increased in his class ranking, I increased my recommendations of the applicant ______ points, or fractions of a point.

F. With all other factors equal, for every 5 percentage points an applicant scored on the MGAT, I increased my recommendation of the applicant ______ points or fractions of a point.
Feedback Explanation

The XXX's refer to the actual weight you used in making your recommendations. This actual weight will be shown on the t.v. screen after you have read these definitions.

A. With all other factors equal, the average difference in recommendation points, or fractions of a point, that you recommended on the basis of the sex of the applicant was approximately XXX. (If this actual value is negative, you rated females more favorably; if this actual value is positive you rated males more favorably.)

B. With all other factors equal, for each job related course an applicant had, you increased your recommendation of the applicant XXX points, or fractions of a point.

C. With all other factors equal, for each year of job related experience an applicant had, you increased your recommendation of the applicant XXX points, or fractions of a point.
D. With all other factors equal, for each point an applicant had on the social skills rating, you increased your recommendation of the applicant XXX points, or fractions of a point.

E. With all other factors equal, for every 5 percentage points an applicant improved in his class ranking, you increased your recommendation of the applicant XXX points, or fractions of a point.

F. With all other factors equal, for every 5 percentage points an applicant scored on the MGAT, you increased your recommendation of the applicant XXX points, or fractions of a point.

The actual answers to these questions will be shown in the right-hand column of the t.v. screen under the heading of 'ACTUAL WEIGHTS'. Please disregard the first column of 1's, that is part of a separate experiment.

When you are sure that you understand what the meaning of these actual weights is, type 'YES', then press return. The t.v. screen will then display your actual weighting strategy for the most recent set of applicants.
Please wait until 'READY' is printed on the t.v. screen before entering 'YES'.
REFERENCES


Slovic, P. and Lichtenstein, S. Comparison of Bayesian and regression approaches to the study of information processing in judgment. Organizational Behavior and Human Performance, 1971, 6, 649-744.


