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THE PRESENTATION OF ALTERNATIVES IN MULTIPLE CRITERIA DECISION SUPPORT

Steven Breslawski
Temple University

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Steven Breslawski
Department of Computer and Information Sciences
Temple University

ABSTRACT

The issue of presenting alternatives to the decision maker in multiple criteria decision support is addressed. The traditional approach, advocated in many multiple criteria techniques, suggests that alternatives should be presented to the decision maker as a vector of criteria scores. We consider the merits of an augmented approach which, in addition to presenting the criteria scores to the decision maker, also makes the values of the underlying decision variables directly available to the decision maker. We describe an experiment where decision makers compare the traditional approach with this augmented approach. In this experiment, a group of decision makers solve a multiple criteria decision making problem which is constructed to uniquely reflect each decision maker's perceptions concerning the decision scenario. We are able to demonstrate that the augmented approach results in 1) the selection of markedly different alternatives than those selected using the traditional approach, 2) an increase in user satisfaction with the information system product, 3) a higher level of satisfaction with the alternative selected.

1. INTRODUCTION

The Multiple Criteria Decision Making (MCDM) problem is typified by a decision maker (or group of decision makers) faced with myriad, non-commensurate objectives (criteria). The task confronting the decision maker is to select the "best" alternative from a feasible set of alternatives. Numerous techniques have been developed to solve MCDM problems. Many have been implemented on the computer. Indeed, a good number of methods are not practical without computer support.

This paper addresses the issue of presenting alternatives to a decision maker in a computer based MCDM system. In particular, we discuss the merits of describing each MCDM alternative in terms of the decision variable values associated with the alternative, as well as the corresponding criteria scores. An experiment for testing the views which we posit is described and the results are discussed.

The motivation for this experiment comes from ongoing research in the area of multiple criteria decision support. This work includes the application of knowledge-based systems in MCDM (Breslawski and Yaverbaum 1988a, 1988b) and the development of mathematical programming systems supporting MCDM techniques (Breslawski and Zionts 1984). In general, most of the MCDM techniques that have been developed have not been embraced by practitioners. It is important to understand and address any inadequacies in these techniques if they are ever to be adopted in an organizational setting. The issue that we focus on in this paper is the presentation of alternatives. A more complete discussion of other deficiencies in MCDM approaches, which have been noted in the literature, can be found in Breslawski and Yaverbaum (1988b).

We present our work in five parts, the first of which has been this introduction. In part two, a terse introduction to multiple criteria decision making, MCDM strategies, and the presentation of alternatives is given. The design of an experiment, where decision makers solve a bicriteria MCDM problem, is described in part three. Measurement issues are also considered. In part four, the results of the experiment are presented and discussed. A summary of our findings and concluding comments are given in part five.

2. BACKGROUND

In this section, a brief background concerning the different schools of thought concerning multiple criteria decision making is presented. We show that although views vary considerably, there appears to be a commonality with respect to how the decision maker is perceived to view the various alternatives. This perception directly affects the manner in which alternatives will be presented to the decision maker in multiple criteria decision support aids.

Many MCDM taxonomies exist. For our purposes, we segregate multiple criteria strategies of choice into two broad categories, normative and descriptive.

2.1 Normative Theories

Normative theories are based on the economist's theory of rational choice. The normative view of the MCDM problem is that the decision maker seeks to maximize a welfare or utility function U by selecting the best alternative x from a feasible set X, $x \epsilon X$. The problem can be stated:

$$\begin{aligned} &\text{MAX} \quad U \\ &\text{st.} \quad x \epsilon X \end{aligned}$$

U is considered to be a function of a p vector Z, which represent the criteria scores for p criteria (objectives) Z_i, i = 1,...,p. Further, $Z \sim f(x)$ and thus each alternative $x \epsilon X$ can be described in terms of a vector $Z \epsilon R^p$. Our problem becomes:

$$\begin{aligned} &\text{MAX} \quad U(Z(x)) \\ &\text{st.} \quad x \epsilon X \end{aligned}$$

If U were known, the problem would become a nonlinear optimization problem (U is seldom assumed to be linear). As U is unknown, other methods must be used to solve the problem. Normative models include ideal point or aspiration models, math programming methods, multiattribute utility or expected utility maximization models, implicit utility maximization, and weighing/scoring methods. Within each of these categories, numerous approaches have been proposed. For a more complete survey of normative approaches, see Evans (1984) or Satty (1980). Normative strategies are sometimes referred to as *prescriptive* strategies, because their end result is the prescription of some course of action deemed to be the best solution to the MCDM problem. **The common denominator in many of these methods is that alternatives are identified by, and presented to the decision maker in terms of, their criteria scores.**

2.2 Descriptive Theories

Descriptive strategies (models) are MCDM strategies observed by behavioral scientists. These researchers view decision making in terms which they feel more accurately reflect the manager's real dilemma than the economist's view of decision making as a (rational) choice from a completely known and delineated set of alternatives. Descriptive theory argues that an exhaustive set of alternatives and their direct consequences is rarely explicit.

This is not to suggest that descriptive theories of decision making have not been advanced which attempt to systematically analyze and define some structure for the task of decision making. Foremost is Simon's (1960) trichotomy of decision making behavior, i.e., intelligence, design, and choice activities. Yaverbaum and Sherr (1986) describe a "stage" model of decision making. The stage model supports the notion that decision makers follow unique processes in achieving goals. This model is based on the work of Cyert and March (1984), Thompson (1967), March and Simon (1958), and Katz and Kahn (1978).

Much of the descriptive theory does not focus on the actual presentation and evaluation of alternatives. However, Klaymer (1982), through empirical observation of actual decision scenarios, has identified several different descriptive strategies; he describes precisely the evaluation of alternatives for each strategy. The strategies are referred to as the additive, additive difference, conjunctive, disjunctive, lexicographic, and elimination by aspects strategies for decision making. **Klaymer's evaluation of each of these strategies implies that each alternative is viewed in terms of its criteria scores.**

2.3 Why emphasize criteria scores?

There are several constructs which support the practice of representing alternatives as vectors of criteria scores. The conviction that we make our decisions in response to some underlying preference structure which is a function of criteria levels is at the heart of rational, economic theory. Further, we need to consider that there are often hundreds of underlying decision variables. Representing alternatives as a $Z \epsilon R^p$ vector of resulting criteria scores is, in essence, presenting an "abridged report" of the underlying decision activity. Summarization of underlying activity is a concept consistent with everyday management practice. Compressing in the direction of more to less is often necessary to combat information overload. Representing alternatives in terms of their criteria scores also forces the decision maker to focus on the consequences of a decision on organizational performance, rather than the specifics of the decision itself.

Some researchers, in the interests of decreasing the cognitive burden on a decision maker faced with making a choice, have espoused that the number of criteria (and thus the amount of information made available to the decision maker) should be limited. Zionts and Wallenius (1983) cite Miller's (1974) magic number seven, plus or minus 2, as a guide for determining a maximum number of objectives to consider. Raiffa, Schwartz, and Weinstein (1977) develop the notion that, in addition to viewing alternatives in terms of their criteria scores, it may be useful to amalgamate related criteria scores into a single overall index. The MCDM work of Satty (1980) also supports the notions of decision hierarchies and increasing aggregation of related, underlying components in the decision making process.

Still, it is widely understood that, in the processes of generating summary statistics, some information is lost. Further, if we accept Mintzberg's (1973) argument that managers make choices in order to satisfy constraints rather than make choices according to some well defined systems of goals or utility (preference) function, then managers need more than just criteria levels to make a decision. We can then conclude that at least some managers would find it useful to have immediate access to the values of the underlying decision variables as well as the criteria scores associated with a given alternative.

Although this additional information might exist implicitly in some form, buried within an information system, its explicit representation and availability to the decision maker on an interactive basis is not specified in the description of MCDM methodologies found in the literature. This is rather unfortunate. In many decision making problems, the objectives may not be clear. Perhaps the decision maker, during the problem formulation and modeling stages, is not aware of or can not articulate the more subtle or secondary objectives of the problem. The presence of additional information, related to these unidentified objectives, could conceivably affect the alternative selected and, hence, organizational performance.

3. AN EXPERIMENT

A simple experiment was designed so that we might test two conjectures: that some managers might experience increased satisfaction with the information produced by the MCDM system if alternatives are described in terms of decision variables, as well as vectors of criteria scores, and that the presence of the decision variable values would cause a different alternative to be selected as the "best" alternative. In designing the experiment, a primary goal was to identify a multiple criteria decision making problem in a domain that was familiar to a large number of individuals. Another goal was to tailor the problem, and consequently the alternatives, to be meaningful to the decision maker. This requires a problem formulation where the coefficients, used to represent the magnitudes and direction of various relationships in the problem, are representative of the preferences and beliefs of each decision maker.

The problem selected was the choice of a meal at a restaurant. Each participant was presented with a list containing 30 food, beverage, and dessert items. The items could be combined to create a meal. The participants were asked to rank each item along the following scales:

Attribute	**Scale**
Taste	-10 to 10
Nutrition	-10 to 10
Filling	0 to 1
Expected Price	0 and up

The idea was to structure the problem, and thus the feasible alternatives, according to the perceptions of the decision maker. For example, one individual might view a baked potato as delicious and nutritious, while another might consider it fattening and unpalatable. The attribute *filling* was used to determine the decision maker's perception of how much of a meal each item comprised. For example, a value of .5 would mean that the decision maker would be half done with their meal. Thus, ambiguities over perceptions of how big a serving is can be controlled for. A serving of broccoli might be given a value of 0.2, while a serving of chicken might receive a value of 0.6. Similarly, the decision maker's perception of price, rather than an actual price, was used to overcome ambiguities.

The participants were given the scenario that they were being taken out to a casual eating establishment by a friend, who would (arbitrarily) spend up to $13 for their meal. Thus cost was not used explicitly as a criteria, but rather as a constraint.

A caloric constraint of 1500 calories was also imposed. Actual calories per serving figures (Krause 1982) were used; the subjects were not asked to provide estimates of caloric content because preliminary tests showed an inability, on the part of the participants, to provide reasonable figures.

Alternatives were generated by modeling the decision problem as the following bicriteria linear programming problem.

Maximize Taste = $t'x$
Maximize Nutrition = $n'x$

subject to:	$f'x \le 1.2$	(filling constraint)
	$p'x \le 13$	(budget constraint)
	$c'x \le 1500$	(calorie constraint)
	$x \le 2$	(upper bound on any one item)

Where:

x is a (30 x 1) vector of decision variables (Number of servings in a given meal for each menu item)

t', n', f', p' are (1 x 30) vectors representing the decision maker's perception of taste, nutrition, bulk, and price respectively for each menu item.

c' is a (1 x 30) vector of calories per serving for each menu item.

The first constraint reflects the concept of not ordering more than we can eat. However, because people often do not eat everything that is placed in front of them, a "eyes bigger than stomach" factor of 20 percent was used. Although the arbitrary nature of this value can be disputed, an exact figure is not required for our purposes. The last constraint reflects the observation that an individual rarely orders more than two of the same menu item (although several participants argued that this constraint should be relaxed for beer, which was one of the menu items).

The participants entered their perceptions of taste, nutrition, bulk, and price into a spreadsheet template. The resulting MCDM problem was solved using a bicriteria version of the Zionts-Wallenius (1983) method of multiple objective linear programming (see Breslawski and Zionts 1988.) The Zionts-Wallenius method presents the decision maker with pair-wise comparisons of alternatives stated as $Z \epsilon R^p$ vectors (a vector of criteria scores). The responses of the decision maker are used to guide a search through the solution space and to eliminate some alternatives from consideration. A bicriteria, personal computer version of a computer package (Breslawski and Zionts 1984) which implements the Zionts-Wallenius algorithm was modified for the experiment. The modification involved retro-fitting the existing package with "windows" through which the underlying decision variables can be viewed.

Because the problem was formulated as a continuous, mathematical programming problem, fractional values for the decision variables resulted. Participants were instructed to consider fractional servings (e.g., 0.9 servings of carrots) as larger or smaller servings than their original perception of
serving size. The appropriateness of a continuous representation of the problem is subject to debate; however, there are two important advantages: 1) it allows alternatives to be generated in a fashion consistent with the stated preferences and perceptions of the decision maker and 2) it lends itself to a problem formulation that is solvable with a readily available MCDM technique.

Each decision maker solved the problem twice. The first time that the problem was solved, only the criteria scores associated with each alternative were made available during the solution process (see Figure 1).

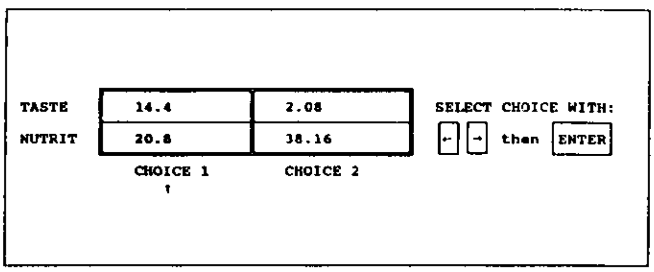

Figure 1. Alternatives Presented as Criteria Scores Only

Only after a final solution had been selected was a window "opened", so that the decision maker could view the decisions associated with the alternative selected. This is analogous to the solution procedure described by many MCDM techniques found in the literature. The second time that the problem was solved,the decision variable window was "opened" for the duration of the solution procedure, making both the criteria scores and decision variable values associated with a given alternative available (see Figure 2).

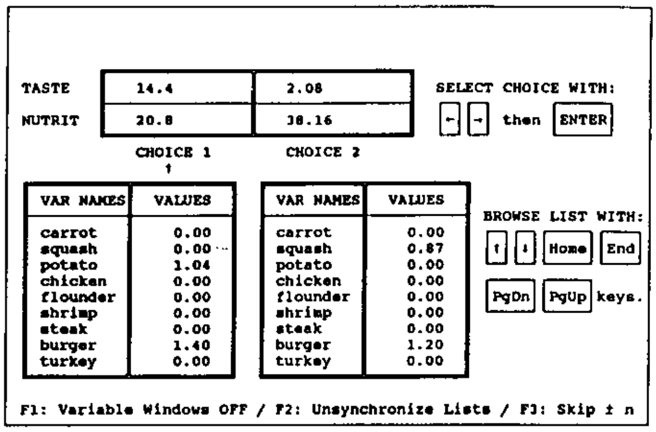

Figure 2. Windows with Decision Variable Values

The order of these two solution techniques was reversed for half of the subjects. To preclude the possibility that a decision maker would merely respect the same sequence of responses from rote memory, the initial starting solution (and thus the subsequent sequence of solutions presented to the decision maker) was changed when the problem was resolved. Two control groups were used. These groups also solved the problem twice, but did not switch solution procedures. The presence of the control groups allows us to ascertain the change in the final solution selected which is attributable to changing solution techniques.

In an attempt to determine whether making additional information available was beneficial, we asked the participants to evaluate their experience by answering nine questions concerning their satisfaction with the information provided by the system and the final meal selected. The answers to the questions took the form of selecting one interval from a seven interval scale. A semantic differential technique (Osgood 1962) utilizing four bipolar adjective pairs per question was used in conjunction with the interval scale.

The nine questions were asked after the problem had been solved, and then again when the problem had been resolved. Seven of the nine questions (and the corresponding bipolar adjective pairs) were extracted from the Bailey and Pearson (1983) User Information Satisfaction (UIS) Survey. UIS measures user satisfaction with an information system and can be used as a mechanism to determine the need for a new information system or whether installed information systems are functioning properly (Ives, Olson, and Baroudi 1983). These seven questions represent a subset of the total UIS survey; this subset is associated with satisfaction with the information product. The remainder of the Bailey and Pearson survey addresses issues which are not applicable to our experiment. The practice of using a relevant subset of questions from the survey is not new (Deese 1979) and has been condoned by Bailey and Pearson (1983 pg. 538) for specific applications.

Ives, Olson and Baroudi (1983) use correlation analysis to show each of the questions in this subset to be construct valid with respect to UIS. Further, factor analysis shows that a majority of the seven questions relate to information system product. In the interest of designing a shorter instrument than that of Pearson and Bailey, some questions were discarded by Ives, Olson, and Baroudi. Because our work uses only a subset of the original Bailey and Pearson questions, the resulting instrument was not excessively long; consequently, we retained all information systems product questions in our survey.

In addition to the seven questions (scales) extracted from Bailey and Pearson, two questions related to the concept of UIS were asked. The purpose was to determine the degree of satisfaction with the final solution (meal) chosen by the participant. Because these questions are specific to a particular solution procedure and decision problem, their spirit is not captured by any question in the UIS survey, which measures general satisfaction with the overall information system. Thus, a total of nine questions related to UIS were asked. The purpose of asking these questions is not to determine a level of overall satisfaction with the system, but rather to determine whether a change in the system (i.e., making the values of the decision variables known during the solution process) has an effect on user satisfaction with respect to the information produced by the system.

Two additional questions were asked, at the beginning of the experiment, to determine whether the user believed that taste and nutrition were important objectives to consider when selecting a meal. A complete list of the questions and bipolar adjectives used in the experiment is given in the appendix.

4. EXPERIMENTAL RESULTS

The scaling of the bipolar intervals was quantified by assigning values of -3 to 3 (with an interval of 1) to the seven scales, with negative values corresponding to the adjective representing the maximally dissatisfied state. Then, for each question, the scores for each of the four bipolar adjective pairs were averaged to yield a composite score for that question. Unlike the Bailey and Pearson study, importance weights were not elicited for each question. Because all questions addressed the information product construct, we felt that all were of equal importance.

In describing the results of the experiment, we define the following phrases:

METHOD 1: Solving the problem with alternatives described in terms of their criteria scores only.

METHOD 2: Solving the problem with alternatives described in terms of criteria scores and decision variables.

The results that we report are derived from a sample of twenty undergraduate business students divided evenly into four groups. Each of the four groups solved the problem twice according to the following scheme.

GROUP	First Solution Procedure	Second Solution Procedure
GROUP A	METHOD 1	METHOD 2
GROUP B	METHOD 2	METHOD 1
GROUP C	METHOD 1	METHOD 1
GROUP D	METHOD 2	METHOD 2

GROUP C and GROUP D were control groups, to be used only in determining whether a change in solution procedure would cause a change in the final alternative selected.

4.1 Selection of Criteria

Two questions were asked regarding the appropriateness of using taste and nutrition as criteria when selecting a meal. These questions were asked before the problem was solved in an effort to pre-screen participants and exclude individuals whose preference structure did not coincide with these two objectives. Recall that the scenario included an acquaintance who would pay the bill, and a modestly priced restaurant. We believe that this resulted in a lack of concern, on the part of the participants, with cost as a criteria. The results reported below are derived from the total sample of 20 participants. See the appendix for the complete questions.

QUESTION	MAX.	MIN.	AVG.	STD DEV.
1) Appropriateness of Criteria	3.0	1.5	2.70	0.358
2) Relative Importance	3.0	1.5	2.59	0.526

Because the average is near the maximally satisfied response of 3 and the standard deviation is small, these results reinforce our confidence in the selection of taste and nutrition as appropriate criteria for this decision problem.

4.2 User Information Satisfaction

Seven questions, designed to measure user information satisfaction with respect to information product, were asked twice; once after the problem was solved via METHOD 1 and again after the problem was solved via METHOD 2. The results reported below are derived from the individuals in GROUP A and GROUP B.

	QUESTION	AFTER METHOD 1 AVG	AFTER METHOD 1 STD DEV	AFTER METHOD 2 AVG	AFTER METHOD 2 STD DEV
1)	Completeness	-0.600	0.708	1.775	0.505
2)	Format of Output	2.250	0.474	2.200	0.291
3)	Language	2.650	0.357	2.500	0.273
4)	Output Volume	1.450	0.430	2.125	0.321
5)	Relevancy	0.275	1.098	1.900	0.357
6)	Perceived Utility	-0.570	0.935	1.525	0.439
7)	Confidence	0.625	0.889	1.350	0.463

The increase in the scores corresponding to METHOD 2 are significant for questions 1, 4, 6, and 7. Significance was determined using a confidence level of .05 in conjunction with a one tail "t" test for individual paired means. Because these survey items have been validated by other studies (Bailey and Pearson 1983, Ives, Olson, and Baroudi 1983), we are confident in asserting that the users were more satisfied with the information product under METHOD 2.

4.3 Reaction To Final Solution

After completing METHOD 1, and then again after completing METHOD 2, two questions were asked to determine how the participants felt about the meal that they had selected with the aid of the system.

	QUESTION	AFTER METHOD 1 AVG	AFTER METHOD 1 STD DEV	AFTER METHOD 2 AVG	AFTER METHOD 2 STD DEV
1)	Satisfaction with meal	-1.15	1.119	0.425	0.821
2)	Completeness of meal	-1.27	0.728	0.225	0.426

The increase in the scores corresponding to METHOD 2 are significant for both questions one and two. A confidence level of .05 was used in conjunction with a one tail "t" test for individual paired means. Because this portion of the survey instrument has not been validated, we are cautious in making the assertion that the participants liked the meal found by METHOD 2 better than that found using METHOD 1. However, given the questions asked (see appendix) and the reaction of the participants during the experiment, we remain optimistic about the validity of such a statement.

4.4 Change in Alternative Selected

In the previous section, we gave evidence that the participants liked the meal selected using METHOD 2 better than that selected using METHOD 1. In order to preclude the possibility that the change in the meal selected was a result of random variation, we compared the results of GROUPS A and B with those of GROUPS C and D, the control groups. A norm for measuring changes in the final meal selected is difficult to design. To merely compare meals on an absolute basis leads to some rather confusing results. Not surprisingly, the meal selected when METHOD 2 was used was different than that selected when METHOD 1 was used for 100 percent of the individuals in GROUPS A and B. However, 60 percent of the control group selected a different meal the second time the problem was solved *even though they used the same method!* As previously noted, the starting solution was changed when an individual solved the problem for the second time; despite this fact, the 60 percent figure was somewhat surprising. Further inspection of the results revealed that although the meals selected by the control group had changed when the experiment was repeated, the criteria scores for taste and nutrition associated with these meals were very similar. For the control group, the average change in the criteria scores was 4.3 percent and did not favor either *taste* or *nutrition*. In contrast, the average change in criteria scores associated with the meals selected by the experimental groups was substantial (31 percent). Interestingly, the meals selected by the experimental groups using METHOD 2 exclusively favored an increase in the *taste* criteria when compared with the meal selected using METHOD 1.

5. SUMMARY AND CONCLUSIONS

We have examined the effect of presenting alternatives of an MCDM decision problem in terms of the decision variables as well as in terms of criteria scores. We described an experiment designed to test the effects of making decision variable values immediately available to the decision maker. The results of the experiment demonstrate:

1) Describing alternatives as a vector of criteria scores, as advocated in many MCDM techniques, may not provide sufficient information for selecting a satisfactory alternative.

2) Decision makers do consult and utilize decision variable values if they are made available.

3) The presence of decision variable values results in the selection of markedly different alternatives than those selected using the traditional approach.

4) The additional information resulted in an increase in user satisfaction with the information system product.

5) A higher level of satisfaction with the alternative selected may be achieved by making decision variable values available.

The purpose of the experiment was to determine, on a preliminary basis, whether our ideas concerning the presentation of MCDM alternatives have any merit. The design of the instrument used has borrowed from the work of others; we hesitate to make strong, statistical statements concerning hypothesis until validation and further development of the survey instrument has taken place. However, these results have provided enough evidence to justify future work in this direction. The results of this experiment should also be strengthened by a larger sample size and repetition of the experiment over several MCDM domains.

One problem to be addressed is how to best make the values of the decision variables available when the number of decision variables is large. In our program, we used a "window" through which the decision maker could view the list of decision variables and their values. Cursor control and function keys allows one to move rather rapidly through the list (refer to Figure 2). However, it may be useful to implement a "search list for:" function and also a mechanism which would allow the decision maker to "mark" the variables in which he/she is most interested. The "marked" variables could then either be displayed in a group or located via a special function key.

In generalizing the results of this study to other areas, we feel that there are three important lessons learned.

1) Although there is support for the notion of summarizing decision activities as criteria scores, and even combining criteria into overall indexes, there may come a point where the decision maker has difficulty in interpreting the meaning of the criteria scores. In our experiment, participants struggled with the concepts of aggregate taste and nutrition in selecting a meal, even though they felt strongly that taste and nutrition were important objectives.

2) When DeSanctis (1984) studied the preferences of managers with respect to graphs and tables, he discovered that the preferred representation of information varied from manager to manager. We can probably make an analogy with respect to the representation of alternatives; detail required will vary from individual to individual. This observation is consistent with one of the basic tenets of decision support: that the varying decision styles of different managers must be supported. **The critical question is, what is the level of granularity that should be provided.** Our experiment shows that granularity required in the context of MCDM may be much more elementary than that specified in MCDM techniques. Researchers concerned with developing efficient MCDM techniques must take this into account when designing algorithms. It is important to design MCDM systems in a way such that, if an individual wants information in addition to criteria scores, it is available on an immediate, interactive basis. Although the statement may appear to be obvious, the implications may not. For example, consider the implications for one class of math programming techniques which generate all efficient or non-dominated solutions before interaction with the decision maker occurs. For each solution, the values of all basic variables must also be generated and stored; this could be fairly cumbersome.

3) In selecting an alternative, decision makers must not only understand the consequences of the alternative (which are manifest in the criteria scores), but they must also understand the alternative. Imagine walking down the aisle of a grocery store and seeing food containers labeled only with price, taste, and nutrition indexes. Although the absurdity of this scenario is self evident, there is a strong analogy between this scenario and the specifications of the many MCDM techniques which present alternatives only as vectors of criteria scores. The importance of making decision variable levels available on an interactive basis is probably most important in MCDM math programming techniques, where alternatives are somewhat obscure, having resulted from the interaction of mathematical constraints. When the alternatives of an MCDM problem are discrete, and may have been identified and described *a priori*, it is seems likely that the decision maker will have a more complete understanding of the alternatives in the feasible set. It is also possible to envision MCDM scenarios where the decision variable values are basically the same as the alternative descriptions. The LAMSADE group in Paris has explored this type of problem in the context of allowing the decision maker to express holistic preferences.

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Appendix

This Appendix contains the questions and bipolar adjective pairs used in the experiment. Two questions were used to determine whether taste and nutrition were appropriate criteria for the decision scenario used. Nine questions were used to determine a level of User Information Satisfaction with the system.

A. Selection of Criteria

1. Appropriateness of Criteria:
   When selecting a meal, the criteria of taste and nutrition are:

   important, not important
   of concern, not of concern
   relevant, irrelevant
   high priority, low priority

2. Importance of Criteria
   When selecting a meal, compared with other criteria, taste and nutrition are:

   more-important, less-important
   primary, secondary
   critical, not-critical
   considered, ignored

B. Information Product Satisfaction

1. Completeness:
   The comprehensiveness of the output information content was:

   complete, incomplete
   consistent, inconsistent
   sufficient, insufficient
   adequate, inadequate

2. Format of output:
   The material design of the layout and the display of the layout contents was:

   good, bad
   simple, complex
   readable, unreadable
   useful, useless

3. Language:
   The set of vocabulary, syntax, and grammatical rules used to interact with the computer system was:

   simple, complex
   powerful, weak
   easy, difficult
   easy-to-use, hard-to-use

4. Volume of output:
   The amount of information conveyed to a user from the computer based system. This is expressed not only by the number of reports or outputs, but also by the voluminousness of the output contents.

   concise, redundant
   sufficient, insufficient
   necessary, unnecessary
   reasonable, unreasonable

5. Relevancy:
   The degree of congruence between what the user wants or requires and what is provided by the system.

   useful, useless
   relevant, irrelevant
   clear, hazy
   good, bad

6. Perceived Utility:
   The user's judgement about the relative balance between the cost (including time) and the considered usefulness of the computer based information provided. Usefulness includes any benefit that the user believes to be derived from the information provided.

   high, low
   positive, negative
   sufficient, insufficient
   useful, useless

7. Confidence in the System:
   The user's feeling of assurance or certainty about the information provided.

   high, low
   strong, weak
   definite, uncertain
   good, bad

C. Appropriateness of Final Solution (meal) Selected.

1. Satisfaction with final meal:
   Your feelings about the final meal selected by the system with respect to your preferences.

   good, bad
   reasonable, unreasonable
   appealing, unappealing
   pleasing, not-pleasing

2. Composition of final meal:
   The logical appropriateness of the meal. How well the menu items fit together.

   complimentary, uncomplimentary
   appropriate, inappropriate
   complete, incomplete
   good, bad