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THE CONCEPT OF WEIGHT IN JUDGMENT AND DECISION MAKING: A REVIEW AND SOME UNIFYING PROPOSALS

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The concept of weight or importance is central to analyses of judgment and decision making. However, different theoretical approaches disagree about the interpretation and operational definition of weight. The purpose of this paper is: (1) to review the various approaches to judgment and decision making, and to consider how each defines weight, (2) to summarize some of the variables that can influence the weight estimates of each approach, (3) to propose a simplifying and hopefully unifying definition

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) of weight, (4) to explore some of the consequences and predictions of this new approach, and (5) to make some suggestions for both language revision and future research which would aid in the development of the weight concept.

"A false balance is abomination to the Lord: but a just weight is his delight" (Proverbs 11.1, King James Bible)

For at least 2,000 years, the concept of weight has been central to any consideration of human judgment and decision making. Indeed, all of the current judgment/decision making (JDM) approaches place the weight concept in a central position (Hammond, McClelland, & Mumpower, 1980). Not only is the weight concept ubiquitous, almost all JDM approaches would agree, at least at verbal level, with the definition provided in Webster's (1976) Dictionary: weight is "the relative importance or authority accorded something." While agreeing at this verbal level, there has been considerable disagreement among JDM approaches about the theoretical interpretations and operational definitions of weight. The purpose of this paper is to review these differences, to propose a unifying definition, and to explore some consequences of this new definition.

Before continuing, an example of how the weight concept would be applied to a JDM problem would be helpful. Suppose you were evaluating or selecting a used car. There would likely be various attributes or dimensions which you would consider. For instance, styling, mileage, and seating capacity might be three such attributes. However, it is unlikely that these attributes would be equally important to you. If the most important dimension is mileage, then it would be said to have the most weight; if styling is the next most important, then it would have the second largest weight; and so forth. Thus, weight reflects the relative importance or salience of an attribute in a multiattribute judgment problem.

This example leads to two comments which should be viewed as caveats for the remaining discussion. First, the judgment problems under consideration involve wholistic stimuli which can be decomposed into separate attributes. For example, a car can be judged on the basis of the attributes of mileage, styling, etc. While a person may use a greater or lesser number of attributes, the nature of the wholistic stimuli (i.e., the car) doesn't change. In contrast, an inapplicable judgment problem would be to evaluate the worth of a commodity bundle of goods, e.g., a basket of groceries. Such a commodity bundle not only lacks any wholistic property, it would not in general have any common attributes. Therefore, the weight concept is applicable to judgments of wholistic stimuli which can be separated into common attributes.

Second, weight is a concept which is tied to an attribute (e.g., mileage), but is in general not dependent on specific alternatives (e.g., a Ford). That is, the weight for mileage will not change as a function of the number of alternative cars considered. While Anderson (1974) among others has proposed models based on differential weights (i.e., where the weights change across alternatives), the present discussion will be restricted to the case of constant weights (i.e., where the weights are constant across alternatives).

These comments or caveats are not intended to be controversial, and basically all JDM approaches agree with them. Where the approaches disagree is in how to theoretically define and operationalize the weight concept. It is these differences that will form the basis of the remaining sections in this paper. Specifically, these sections will cover: (a) a review of the various approaches to JDM along with the weight definitions and operationalizations used by each, (b) a consideration of the various factors that can influence the weight values obtained by these various approaches, (c) a proposal for a simplifying and hopefully unifying definition of weight, (d) an exploration of some of the consequences and predictions of this new definition, and (e) a discussion of some suggestions for future research that would aid in the development of the weight concept.

Previous Theoretical Definitions

At a surface level, the weight definitions used by the various JDM approaches appear remarkably similar (Shanteau & Phelps, 1977); the first part of this section will be devoted to a discussion of this similarity. In addition to defining weights similarly, all JDM approaches contain a complementary concept of utility or scaling value; the second part will consider this complementarity in more detail. Beneath the surface similarities, however, there are some fundamental differences between the definitions and operationalizations used by various JDM approaches; these unique aspects will be reviewed in the third part. While formal JDM approaches with explicit definitions are of primary concern, there have also been a number of less formal, implicit definitions of weight in psychology; some illustrations of the implicit use of weight will be considered in the final part of the section.

General Overview

The concept of weight appears in all present approaches to JDM. Moreover, it is used by all approaches to reflect the relative balance or tradeoff between the importance of various attributes. The concept of weight as something to be traded off has both historical and theoretical interest. Historically, the idea that weight reflects a balance or a tradeoff dates back to antiquity (see the initial quote from the Bible). Significantly, there has been little change in this basic view of weight over the intervening years. Theoretically, the concept of weight as a balance implies that it is a limited or finite entity. Since there is only so much weight to go around, tradeoffs are a necessity: if the weight on one attribute increases, the weight on some other attribute(s) must correspondingly decrease.

At a more formal level, this common view can be stated in terms of a weighted linear model. The following general model can be used to describe almost all JDM approaches:

$$R_j = \sum_{i=1}^{I} w_i \, x_{ij}, \text{ where } \sum_{i=1}^{I} w_i = c. \qquad (1)$$

R_j is the response (either a judgment or a decision) to the j-th alternative. The weight, w_i, is the relative importance attached to the i-th attribute; the sum of the weights across all I attributes is constrained to equal a constant, which typically is 1. x_{ij} is the scaling or utility value for the i-th attribute of the j-th alternative. The overall judgment, therefore, can be described as the sum of the products of weight times scaling value.

Interpretationally, the constraint on the sum of the weights is quite significant for two reasons. First, it is this constraint that leads weight to be tied to tradeoffs. Second, this constraint makes Equation 1 into a weighted averaging model. That is, the judgment will reflect the weighted average of the various scaling values for the multiple attributes. Thus, the response will necessarily lie intermediate to or represent a compromise among the set of attribute values.

Complementarity of Scaling Values

While often overlooked, any discussion of weight must take into account the nature of the associated scaling or utility value. Put more directly, the weight concept cannot be considered independently from the concept of scaling value. The reason for this can be seen in Equation 1: weight and scaling value are part of a complementary, two-parameter representation of information impact. Thus, the impact that a variable has on a judgment can show up either in the weight or the scaling value (or both). In other words, there are two ways in which an independent variable can have an influence on a judgment: either through the weight parameter or through the scaling parameter.

Because of this complementarity, it is necessary when considering how a JDM approach defines weight to also consider how it defines scaling value. The importance of maintaining this parallel consideration of weight and scaling value will become clear later. Consequently, attention will be focused equally on the two parameters in the remainder of this section.

Prior definitions of weight and scaling value can be separated into those which provide explicit definitions and those which provide only implicit definitions. In the explicit cases, the use and measurement of the parameters is well defined and can be stated in formal mathematical terms. In the implicit cases, the use of weight and scale values is less well defined and the measurement issue is often not considered at all. The explicit and implicit uses of weight/scaling value will be reviewed in the last two parts of this section. Incidentally, the selection of JDM approaches parallels, but does not duplicate, the discussion in Hammond et al. (1980). For a greater breadth of presentation and a wider variety of references, the interested reader should refer to this source.

Explicit Definitions

Decision theory. The most formal and abstract of the JDM approaches is that of Decision Theory (DT). This approach has its origins in economic/statistical considerations and is consequently the least psychological in its orientation. Nevertheless, it does contain subjective elements and is considerably more psychological than purely economic/statistical theories. Mathematically, the basic decision model for two attributes, Y and Z, can be stated as follows (from Keeney & Raiffa, 1976, p. 271):

$$\mu(y, z) = k_y \mu_y(y) + k_z \mu_z(z), \text{ where } k_y + k_z = 1. \quad (2)$$

This says that the utility of the combination, $\mu(y, z)$, is equal to the weighted sum of the separate utilities, $\mu_y(y)$ and $\mu_z(z)$. k_y and k_z are scaling constants which are normalized to sum to 1. However, Keeney and Raiffa (1976, p. 273) emphasize that "scaling constants do not indicate the relative importance of the attributes" (italics theirs). Thus while scaling constants have the same form and constraints as weights, they should be approached psychologically with great caution.

The utilities are defined by reference to either a value function (for decisions under certainty) or a utility function (for decisions under uncertainty). In either case, a function is derived which relates objective values, Y or Z, to economic utility values, $\mu_y(y)$ or $\mu_z(z)$. Two other comments are relevant: First, the utility values are rescaled to equivalent ranges from 0 to 1. Second, utility (or value) functions can only be defined for numerical or objective attributes, e.g., cost. Thus, DT definitions are generally parallel to economic utility analysis.

The basic procedure used by DT involves having subjects make a series of preferential choice judgments. Subjects are asked to make paired comparisons between wholistic (nondecomposed) alternatives, such as a 1976 car for \$3,000 with 20 m.p.g., or a 1978 car for \$5,000 with 30 m.p.g. The research strategy is to systematically manipulate the attribute values until an indifference point (no preference) is found. Using a series of indifference points, utility functions can be constructed for each attribute. The scaling constants can also be obtained using the indifference-point strategy. The appropriateness of the derived values can then be evaluated through tests of various ordinal properties of the DT model. These tests are carried out using paired-comparison procedures.

<u>Behavioral decision theory</u>. A related approach to DT is that of Behavioral Decision Theory (BDT). BDT is also influenced by economic analysis, but psychological considerations are probably equally important. That is, BDT combines elements of economical and psychological approaches. Formally, the basic combination model for the multiattribute case is as follows (adapted from Gardiner & Edwards, 1975, p. 18):

$$U_j = \sum_{i}^{I} w_i \mu_{ij}, \text{ where } \sum_{i}^{I} w_i = 100. \qquad (3)$$

U_j is the total utility for the j-th alternative, and μ_{ij} represents the utility value for the i-th attribute of the j-th alternative. w_i is the normalized importance weight for the i-th attribute. The weights are constrained to sum to 100, and are interpreted psychologically in terms of relative attribute importance.

The utilities in BDT are defined by means of a value curve. This is a function relating attribute values to their relative desirability or utility. The attributes values should cover the plausible range of alternatives, and the utility values, μ_{ij}, are normalized to range from 0 to 100. While similar in many respects to the utility function used in DT, the value curve of BDT is not restricted to numerical attributes. Thus, values curves can be derived for either objective (e.g., cost) or subjective (e.g., styling) attributes.

The procedure used by BDT is based on having subjects give direct estimates of weights and utilities. For weights, subjects are asked to rate the importance of each attribute (e.g., "how important is cost in selecting a car"). For utilities, ratings are obtained on an attribute-by-attribute basis (e.g., "rate a cost of $2,000 for a car"); typically, a linear value function is then fit to the ratings. Neither the appropriateness of these values nor the goodness of Equation 3 is generally tested in BDT.

Psychological decision theory. The approach labeled Psychological Decision Theory (PDT) by Hammond et al. (1980) is in reality a combination of eclectic theories and methodologies from a common group of researchers. Most of the earlier work (e.g., see the review by Slovic & Lichtenstein, 1971) shares important features with the Social Judgment Theory approach which follows; this work will therefore be presented in the next segment. One PDT approach that is different is the recent development of prospect theory by Kahneman and Tversky (1979). Accordingly, this approach will be presented here. Prospect theory attempts to incorporate specific psychological processes into an economic framework. The basic statement of prospect theory is as follows (adapted from Kahneman & Tversky, 1979, p. 276):

$$V_{xy} = \pi(p)\ \mu(x) + \pi(q)\ \mu(y), \text{ where } \pi(p) = \pi(q) \leq 1. \qquad (4)$$

V_{xy} represents the total value of the risky components X and Y, where $\mu(x)$ and $\mu(y)$ are the separate utility values. p and q reflect probabilities with $\pi(p)$ and $\pi(q)$ referred to as decision weights; the weights are constrained to sum to less than one. However, Kahneman & Tversky (1979, p. 280) caution that decision weights "should not be interpreted as measures of degree of belief." Nevertheless, it is clear that these have the same form as the weights in Equation 1, that their sum is constrained, and that they depend on psychological considerations. Moreover, Kahneman and Tversky (1979, p. 275) state that "a decision weight . . . reflects the impact of p (probability) on the overall value of the prospect." As such, decision weights appear to be quite similar to weighting concepts proposed earlier by Edwards (1962) and Anderson and Shanteau (1970).

The utility values in Equation 4 are defined by means of a value function. This is basically a utility function defined on relative changes in wealth or welfare (as opposed to the absolute changes typically used in economic analysis). That is, increments or decrements in wealth are used to define relative rather than absolute utility. In addition, there are two other differences from the utility functions defined for DT or BDT. First, the value function is not normalized, except to start at zero, and so there is no upper bound or maximum value. Second, it would appear that prospect theory is restricted to monetary attribute values; that is, value functions are not defined for nonmonetary attributes.

The procedures used to operationalize prospect theory have yet to be made explicit. However, it appears that paired-comparison procedures, similar to those used by DT, would be compatible with the theoretical definitions. Also, there appears to be no established means for testing the adequacy of prospect theory, although conjoint measurement techniques (Krantz & Tversky, 1971) may well be applicable.

The three approaches reviewed thus far reflect a concern for incorporating psychological processes into economic/statistical analyses. In contrast, the remaining two approaches have an entirely psychological orientation with no concern for economic theory.

Social judgment theory. The lens model described by Brunswik (1956) is the basis for the Social Judgment Theory (SJT) approach. The lens model is based on regressional/correlation statistics, and leads to the following expression (adapted from Hammond, Stewart, Brehmer, & Steinmann, 1975, p. 278):

$$Y_j = \sum_{i=1}^{I} b_i \, x_{ij}, \text{ where } \sum_{i=1}^{I} = 1. \qquad (5)$$

Y_j is the observed judgment for the j-th alternative or "profile." X_{ij} is the value for the i-th attribute or "cue" on the j-th alternative. The b_i are regression weights which are rescaled from standardized Beta weights to sum to 1 (or 100). These weights reflect "the relative importance judges place on cues (attributes) in making judgments . . ." (Hammond et al., 1980, p. 217). Not only are the weights in SJT given a clear psychological interpretation, they are frequently used as feedback in learning or in reducing interpersonal conflict.

The cue values in SJT are defined by means of a function form. This is a function relating the attribute value of a cue with the desirability of the cue value. That is, "the function form relates values of an attribute . . . to values of the judgment" (Hammond et al., 1980, p. 210). Function forms are rescaled to cover a common range, typically going from 1 to 20. While superficially similar to the utility functions used by DT, BDT, and PDT, function forms are different in two important aspects. First, the attribute values can come from any quantifiable source. That is, they can be either measured numerically on an objective scale (e.g., miles per gallon) or measured subjectively on a rating scale (e.g., attractiveness of styling). Second, the function form is philosophically in the tradition of a psychophysical function (e.g., note Brunswik's concern with perception). In contrast, utility functions are philosophically the result of an economic approach to decision making.

The procedure used by SJT to derive weights and function forms is based on multiple-regression analysis. Subjects are asked to judge a series of wholistic stimuli or profiles (e.g., a 1978 car for $4,000 with 20 m.p.g.). Based on a set of profiles, the judgments are analyzed using regression techniques. The numerical stimulus values are the predictors and the observed judgments are the criterion in the regression analysis. Statistically optimal weights, which maximize the fit of the regression model, can then be obtained. In addition, the SJT approach, by including squared as well as linear terms, produces a function form for each attribute dimension; this describes the form of the function (either linear or U-shaped) relating objective and subjective attribute values. Support for regression techniques is usually reported in the form of R^2 or percent variance-accounted-for measures.

Information integration theory. The last of the formal approaches to JDM is Information Integration Theory (IIT). This approach is entirely psychological with a total emphasis on subjective values and models. Indeed, economic or objective values play no role in IIT analyses. While allowing for a variety of judgment models in other tasks, the appropriate model for the multiattribute case is the constant-weight averaging model (adapted from Anderson, 1974, p. 239):

$$R_j = \frac{\sum_{i=o}^{I} w_i s_{ij}}{\sum_{i=o}^{I} w_i} \qquad (6)$$

R_j is the observed judgment to the j-th alternative. s_{ij} represents the scale value of the i-th attribute for the j-th alternative. w_i is the relative weight of the i-th attribute, and is constrained by the denominator to effectively sum to one. Weight can be defined as relative importance or "as the amount of information in the stimulus" (Anderson, 1974, p. 238). However, IIT also emphasizes the multidimensionality of influences on weight be recognizing that many factors may influence weight (see below).

The scale value in IIT is defined in terms of the location of the attribute on the dimension of judgment. This is entirely a subjective concept with no reference to objective attribute values. In other words, scale values can be evaluated for such subjective attributes as overall impressiveness or design attractiveness. Of course, scale values can also be obtained for objective attributes such as cost. However, no attempt is made a priori to use or compute a function relating scale values to objective values, although such a function can be obtained after the fact (i.e., after the scale values have been obtained).

Two other comments are appropriate about IIT. First, it recognizes that both weight and scale value may depend on the dimension of judgment. That is, a given stimulus attribute may have different relevance (i.e., weight) and different valence (i.e., scale value) across different judgment tasks. Second, the inclusion of initial-state parameters, w_o and s_o, is unique to IIT. These allow for the influence of an initial impression or a prior opinion on the judgment.

The procedure used by IIT to estimate weight and scale values is based on three steps. First, the subject evaluates a set of wholistic stimuli which are generally, but not always, constructed from a factorial design. Second, the set of judgments is used to test the adequacy of the averaging model in Equation 6. Third, if the model passes the tests, then it is used to provide estimates of both weights and scale values. Thus, it is clear in IIT that the weight and scale values are only as good as the averaging model on which they are based. While the same dependence is true for the other JDM approaches, IIT is unique in testing the model first. Typically these tests make use of analysis-of-variance procedures to examine deviations from the model.

These five explicit approaches, summarized in Equations 2 to 6, do not exhaust the formal mathematical approaches to JDM which incorporate a weight concept. For instance, models of attitude change have frequently incorporated a weight or belief parameter (e.g., Fishbein, 1967). And recently, weights have been added to scale values in the conjoint measurement analysis of ordinal data (Luce, 1980; McClelland, 1980). These and other formulations fit into the general weighted linear model described in Equation 1. However, these other approaches add little to those already presented. That is, the five explicit approaches illustrate the range and variety of definitions given to weights.

Implicit Definitions

In addition to the five preceding approaches which explicitly incorporate a weight parameter, there are numerous instances in the literature of the implicit use of weight. Two examples of these implicit usages will be presented here. However, because the weight concept has not been formalized in these applications, they cannot be incorporated into the remaining sections of the paper. Nevertheless, the implicit approaches are included to illustrate the widespread use of the weight concept in research on human judgment.

The first example of implicit weight is drawn from Attribution Theory (AT). This approach reflects the cumulative contributions of many researchers in social psychology. Starting with the fundamental developments of Heider (1958), significant advances were made by Kelley (1973) and Jones (e.g., Jones & Davis, 1965). Briefly, the goal of AT is "to develop general laws of inductive knowing or inferences about the locus of causality" (Hammond et al., 1980, p. 106). Frequently, in an effort to describe causal attributions, reference is made to subjects using or not using some source of information. For example, base rate or consensus information is frequently ignored in forming casual attributions (e.g., Nisbett & Borgida, 1975). The level of the base rate would be its scaling value and the importance would be its weight, which is apparently zero in this case. Thus, the concept of weight (and scaling value as well) is implied, but there is no attempt to formalize or measure it.

The second example comes from work on Impression Formation (IF). While much of the earlier research on IF makes use of the personality impression paradigm introduced by Asch (1946), more recent research has explored impression formation in a variety of areas such as impressions of historical figures (Anderson 1973) and consumer impressions of products (Troutman & Shanteau, 1976). In most of this research, the essential problem has been to relate the impression formed to the characteristics of the stimulus information. For example, a common finding (from Asch, 1946) has been that earlier information has more impact than later information, i.e., a primacy effect. While this has frequently been interpreted to imply a "change of meaning" of later information, alternative explanations have been offered in terms of serial position effects. These two interpretations can be readily translated into a scaling-value shift versus a primacy weighting effect. Unfortunately, much of the debate over "change of meaning" has proceeded without recognition of the implicit role of weights and scaling values (although see Anderson, 1974).

These two examples, while far from exhaustive, demonstrate how widespread the implicit use of weight is in the literature. Unfortunately, researchers have often failed to recognize that they were dealing with an issue involving a weight concept. As a consequence, there have been a great many inefficiently or incorrectly designed studies involving implicit weights. For instance, IF researches have frequently asked whether positive or negative information has greater impact in forming an impression. The typical research strategy has been to try to construct equivalent positive and negative stimuli (i.e., with equal but oppositely signed scaling values); the question is then which produces more extreme responses. While this procedure might work in theory, it has serious flaws in practice. For instance, any deviations from equal scaling values will invalidate this procedure; unfortunately, such deviations are almost bound to occur due to individual differences, changes over time, etc. A much more direct approach would be to recognize that the research question is one of weight, and that the extremity of the stimuli is reflected by scaling values. What is needed is to derive estimates of weight (and if desired scaling values); however, there is no need to equate stimulus extremity, and indeed, different subjects are quite likely to have different scaling values for any set of stimuli. Such an approach is not only more general, it provides a more direct answer as to what kind of information is more important. As this example hopefully illustrates, a greater recognition of the role of weight would lead to better research in many cases.

Factors That Influence Weight

There are a wide variety of factors that have been found to influence weight and/or scaling values. A few of the more widely reported factors will be reviewed in this section. There are two purposes behind this review. The first is to demonstrate that weight (and scaling value) is a multifaceted concept with many determinants. The second is to show that the various approaches handle the multiple facets in different ways. Therefore, following a brief review of each factor, there will be a discussion of how that factor is handled by each approach to JDM.

Salience. The first and most widely discussed influence is that of salience (or inherent importance). Indeed, the terms are often used interchangeably so that a dimension with greater weight is said to be more salient. However, as will be made clear below, weights can be large or small for a variety of reasons. Thus, it is not generally correct to equate weight and salience or importance.

All of the JDM approaches assume that salience is reflected by the weight parameter. That is, as importance goes up and down, weight will go up and down in a corresponding fashion. However, this correspondence is not necessarily proportional and may with some approaches (e.g., DT) only be an indirect relation.

Scale or utility value. While importance is naturally a part of weights, scale or utility value is naturally a part of scaling value.

Scaling value is typically defined by the location (or amount) of the stimulus along the dimension of judgment. Thus, the greater the mileage of a car, the greater would be its scaling or utility value; the preferability of the car would presumably also increase with greater mileage.

Despite its apparent simplicity, it would be a mistake not to explore the scaling/utility value concept in more detail. Scaling value, as normally used in research, is clearly a unidimensional simplification of a complex multidimensional process. That is, any particular stimulus object may have many different scaling values depending on the judgment context. Thus, the size of a car may lead to a large or a small scaling value depending on whether carrying capacity or handling ease is being judged. These various scaling values can be used to locate the stimulus in a multidimensional space. Typically, the dimension of judgment will specify how to slice through this space for any particular problem. Since different research problems can lead to different slices, this suggests that it is natural to expect to have different scaling values for the same object in different judgment contexts.

In practice, the various approaches have chosen to concentrate on different aspects of scaling/utility values. For instance, some approaches such as DT or BDT consider only the preferential-utility aspect of scaling values. Other approaches, e.g., prospect theory, are restricted to utilities in an uncertain environment. Regression-based approaches, such as SJT or some aspects of PDT, rely on a physical metric or objective values to define scaling values. Finally, some approaches such as IIT or conjoint measurement evaluate scaling values along whatever subjective dimension is used by subjects for a particular problem.

Range. While both salience and scale/utility value can be simply and directly defined, this is not the case for range effects. The basic idea is simple enough: the range of the alternative stimuli along an attribute may have an impact on the weight given that attribute. Thus, range is manipulated by increasing or decreasing the spread of the alternative stimuli along an attribute dimension.

However, there are at least two, and possibly more, ways that any effect from range can be interpreted. The first is to describe the effect of range on the attribute dimension as a whole. For example, the importance of gas mileage as an attribute might depend on whether there is a broad or narrow range of gas mileage across the alternatives. The second way to interpret range is to consider only a given subset of alternatives and to ask whether their weight is increased or decreased by changes in the overall range of alternatives. In judgment research, the former view of range effects tends to dominate (e.g., John & Edwards, 1978), whereas the latter view is primarily found in perceptual or psychophysical research (e.g., Helson, 1964). Since the difference between these two views has yet to be resolved, the present discussion will be kept general enough to apply to either. However, the interpretational ambiguity surrounding range effects should be kept in mind in the future discussions.

While most of the JDM approaches recognize that range effects are important, there is some disagreement as to how to describe such effects. BDT and SJT, on the one hand, include range effects in the weight parameter; for DT it is less clear, but range might be included in the scaling constant, i.e., weight. For IIT, PDT, and approaches such as conjoint measurement, on the other hand, range effects are included in the scaling parameter. Thus, all approaches provide some means of describing range effects.

Serial position. The order in which stimulus information occurs has frequently been reported to be an important variable (e.g., Slovic & Lichtenstein, 1971). For instance, a primacy effect implies that early information has greater influence than later information. Similarly, a recency effect implies that later information has greater influence. Which applies appears to depend on variety of procedural and other variables.

Although most judgment/decision researchers would readily recognize the importance of order effects, few of the JDM approaches are explicit on how to incorporate order. One exception is IIT which clearly incorporates order effects in the weight parameter (e.g., Shanteau, 1970). Other approaches such as PDT and SJT could potentially handle order effects but as yet have not done so. Finally, DT and BDT neither recognize nor incorporate order as a relevant variable.

Scaling constant. While not strictly an experimental variable, there are several types of scaling constants that can influence the estimation of weights and scaling values. Typically, such constants arise when various parameters (e.g., utility functions for different attributes) are transformed or normalized onto a common scale. The usual procedure is to rescale the various values so that they have the same range; another technique is to rescale the values so that they have a common unit on an interval scale. Either way, scaling constants are introduced in the process of rescaling the values.

Some approaches, such as DT, are quite explicit about the use of scaling constants in estimating weight values; indeed, DT equates weights with scaling constants. Other approaches such as SJT and BDT make use of normalization procedures which introduce scaling constants into both weights and scaling/utility values. The situation for PDT is less clear, although scaling constants would apparently be a part of any weight estimates. Finally, IIT and conjoint measurement values (as modified by McClelland, 1980) do not have scaling constants, since no normalization is used in estimating either weights or scaling values.

Miscellaneous. There are a variety of other variables which have been shown at one time or another to influence weight and/or scaling values. However, only one of the JDM approaches may have taken an interest in this variable. Thus, it becomes difficult, if not impossible, to say how the other approaches would interpret the variable. Such variables have, therefore, been classified under miscellaneous or other effects.

As an example, frequency effects due to differential distributions of stimuli have been found to be influential in psychophysical research (e.g., Parducci, 1965). Such effects have been incorporated into the IIT framework (Birnbaum, Parducci, & Gifford, 1971). However, there is no other approach which has been specific on how to incorporate frequency effects.

A somewhat different problem arises for probability. Strictly speaking, probability is not an attribute in the usual sense, i.e., it is not a part of a stimulus object. Nevertheless, probability is often viewed as an important component in many decision problems. More importantly, probability has frequently been suggested as influencing weight and/or scaling values. For instance, probability is tied in directly as part of the decision weights in prospect theory. SJT, on the other hand, would apparently treat probability as a separable cue value. Both BDT and IIT have incorporated probability into a weight-like parameter. Finally, DT provides different definitions of utility depending on whether the problem involves uncertainty or not: utility functions are defined for uncertain problems, whereas value functions are defined for problems involving certainty. Thus, probability is dealt with in a variety of different and often inconsistent ways by the various JDM approaches.

Another example is that of credibility or believability of the information. It has frequently been reported that more credible information is attended to more. Such effects have been incorporated into IIT weight values by Birnbaum and Stegner (1979). No other approach, however, has considered the effect of credibility.

The final example comes not from an effect on weight, but rather from the effect that weight has as a feedback device. SJT is unique in stressing the role that weights can play in providing feedback to subjects in a learning or conflict resolution paradigm. That is, weights estimated from subjects' judgments can be used as an informational tool in modifying subjects' future judgments. Weights as defined by SJT have proven to be effective in this context (Hammond et al., 1975). Whether SJT weights are the best for such purposes has yet to be demonstrated.

While additional factors might be considered, the inclusion of other variables would needlessly lengthen the paper without leading to any changes in the arguments to be presented. Therefore, only the variables considered thus far will be discussed further.

Proposed Definition of Weight

As the preceding discussion illustrates, different JDM approaches have defined weight in a variety of often conflicting fashions. While almost all researchers agree that weight should reflect salience or importance, there is little agreement as to the role of the other variables mentioned above. For instance, BDT and SJT include range effects in the weight parameter; IIT and prospect theory, on the other hand, include range effects in the scaling parameter; for DT, there is some uncertainty, but range apparently influences weight.

Thus, there is considerable disagreement about how to conceptualize weight. Moreover, there has been almost no research on how best to define the complementary concepts of weight and scaling value. Accordingly, research at both the theoretical and empirical level is certainly to be encouraged (see the last section on research recommendations). However, given the present state of affairs, the problem remains as to what can be done to reduce the current confusion and lack of communication about the definition of weight. The remainder of this section will take up this problem in greater detail.

This material will be divided into three parts: First, some basic premises and assumptions about weight will be discussed. Second, a unifying definition of weight will be proposed. Third, the various factors reviewed in the preceding section will be incorporated into the proposed definition.

Some Premises about Weight

In trying to suggest a definition that can be widely accepted, it is necessary to consider some premises or starting points. These premises are based either on assertions that have been repeatedly accepted, or on assumptions that apparently do no violence to any particular point of view. Five such premises will be considered.

The first premise is that weight must involve the concept of salience or importance. This is widely assumed and is necessary for any definition of weight. Thus, above all, weight should reflect the dimensional importance of the attribute or source of information. Of course, this does not rule out the influence on weight of other variables.

The second premise is that weights should be independent of scaling values. While weight refers to attribute importance, scaling value refers to the level of the attribute. In other words, weight applies to a dimension as a whole, whereas scale value applies to a location along the dimension.

The third premise is that weights should be constrained to sum to unity. This means that any one weight value will necessarily depend on the total of the other weight values. Thus, weight is a relative, not an absolute, concept.

The fourth premise, which is really more of an observation, is that both weights and scaling values will be task dependent. That is, different values will be observed depending on the nature of the task and the judgment context. This means that parameter invariance will be the exception rather than the rule. For an empirical demonstration of this observation, see Ptacek and Shanteau (1980).

The last premise is that both weight and scaling value are only as good as the theory from which they are derived. These values are nothing more or less than parameters of the weighted linear model in Equation 1. Like any parameter, the estimated weights and scale values depend on the validity of the underlying assumptions. Thus, the more completely the model assumptions are tested, the more believable will be the weight and scaling estimates.

These five premises can be summarized as follows:

1) weights should reflect salience or importance,
2) weights should be independent of scaling values,
3) weights should be constrained to sum to unity,
4) weights should be task dependent, and
5) weights should depend on model validity.

While more precise mathematical specifications of these properties are possible, (e.g., see McClelland, 1980), these verbal statements should suffice for present purposes.

A Definition of Weight

The proposed definition of weight will be presented in two steps.

The first step is based on a generalized geometric interpretation of weight and scaling values that can be applied to all JDM approaches. The second step involves showing how the various factors considered in the preceding section can be incorporated into the definitions for each approach.

<u>Geometric interpretation</u>. A generalized geometric description of weight and scaling values is illustrated in Figure 1. Two stimuli, S_1 and S_2, have been shown as masses applied at various distances from a fulcrum. The mass corresponds to the scaling values, s_1 and s_2, and the distances correspond to the weights, w_1 and w_2. The response, R, is applied at a distance equal to $w_1 + w_2$. Thus, the total force on the left side is equal to $w_1 s_1 + w_2 s_2$, and the force on the right is $(w_1 + w_2)$ R. Equating these two forces and moving the sum of the weights, the following expression applies:

$$R = \frac{w_1 s_1 + w_2 s_2}{w_1 + w_2} \quad . \qquad (7)$$

That is, the response is equal to the weighted average of the two masses. Since $\frac{w_1}{w_1 + w_2} + \frac{w_2}{w_1 + w_2} = 1$, Equation 7 is formally equivalent to Equation 1; note also the equivalence of this equation to the weighted averaging model of IIT in Equation 6.

Another way to look at Figure 1 would be to let the sum of weights, $w_1 + w_2$, on the right equal unity. This can be done with no loss of generality since it merely sets a unit value on the ratio scale of weights. Now,

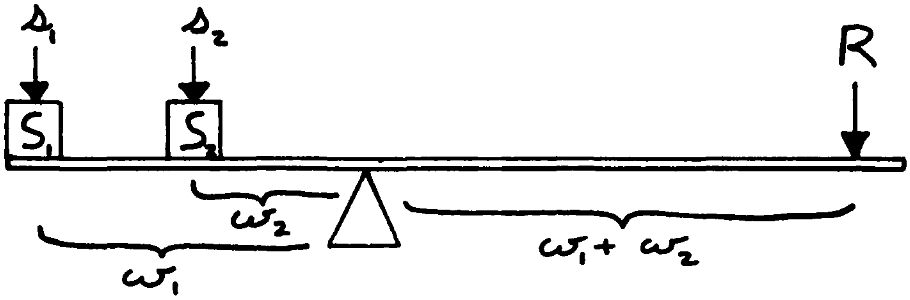

Figure 1. Geometric representation of proposed definition of weight and scaling value. S_1 and S_2 are masses applied around a fulcrum. The masses correspond to scaling values, s_1 and s_2, and the distances, w_1 and w_2, correspond to weights. The response, R, is at a distance $w_1 + w_2$.

Equation 7 can be restated in the more familiar form of Equations 1 to 5:

$$R = w_1 s_1 + w_2 s_2, \text{ where } w_1 + w_2 = 1. \qquad (8)$$

The difference between Equations 7 and 8 is that absolute weight is used in the former and relative weight is used in the latter. The relative weight can be thought of as the effective or tradeoff weight. Absolute weight , on the other hand, reflect an unconstrained or raw measure of importance. While both types of weights must be normalized, absolute weights are normalized by the sum in the denominator of Equation 7 and relative weights are normalized by the external constraint in Equation 8.

Three additional points can be made from Figure 1. The first is that the impact of a stimulus can be increased by either increasing its weight or increasing its scaling value. While this may seem obvious, what is less obvious is that the impact of a stimulus can be described by an infinite number of weight-scaling value combinations. That is, the same force can be obtained in many ways. What is needed to solve this problem is some additional constraint. Such a constraint is provided by the form of averaging model. As noted before, the averaging property of the model produces a constraint on the sum of the weights. Thus, it is the averaging characteristic which provides the potential for unique solutions to weights and scaling values. While this potential has been recognized by DT and IIT, the other approaches have not dealt with the uniqueness problem.

The second point is that the product of weight and scaling value corresponds to the force applied around the fulcrum. Such force corresponds to the total impact that a stimulus has. As recommended below, the term impact will be used any time the joint effect of weight and scaling value is described. In the past, there has been some confusion about the joint interpretations of weight, scaling value, and impact. Figure 1 and the present definition of impact should reduce such confusions.

The final point is to illustrate how the term "weight" can be misleading and potentially confusing. The use of a balance around a fulcrum to graphically demonstrate the judgment process is not unique. Previous applications of a balance and fulcrum argument have appeared in Anderson (1974), Birnbaum and Stegner (1979), and Krantz (1974). Yet in all these applications, the masses, s_1 and s_2, in Figure 1 were interpreted as weight values and the distances, w_1 and w_2, were interpreted as scaling values. In other words, weights and scaling values were reversed from the present picture. The reason for this is obvious: since mass operates like a physical weight, it has been labeled with the term "weight." Yet as shown in Figure 1, a simpler and more direct interpretation is available if the distances are identified with weight. This is just one example of how the many meanings of the word weight have caused needless confusions (see the last section for some recommendations on this point).

Elaboration of the Definitions

Based on the preceding comments, it is now appropriate to turn to a more detailed consideration of weight and scaling value. The goal is to be more specific about what variables or factors go into each definition. The general approach will be to describe how the various factors from the preceding section (on "Factors That Influence Weight") enter into the definitions for each JDM approach.

To facilitate the discussion, the various variables will be denoted by letters: Salience or importance will be referred to as "w". Scaling or utility value will be denoted by "s"; when applicable, the physical or objective value of the stimuli will be described as "S." Range effects will be denoted by "r." Serial position or order effects will be referred to as "o." Scaling or normalizing constants will be denoted by "c." When necessary, "m" will be used to refer to miscellaneous or other variables. To summarize, the notation is as follows:

w = salience or importance,

s = scale/utility value,

S = physical or objective stimulus value,

r = range effects,

o = serial position or order effects,

c = scaling or normalizing constants, and

m = miscellaneous or other variables.

These variables are sufficient for present purposes. However, the list is not intenued to be exhaustive and further refinement is certainly to be encouraged.

Elaboration of weight. The next step is to use these variables to characterize the various definitions of weight. An absolutely "pure" measure of weight would reflect only salience:

$$\text{weight}_{\text{PURE}} = w.$$

There is, as yet, no known procedure that can provide such an uncontaminated estimate of weight. Instead, all JDM approaches lead to weights which reflect a combination of factors.

For example, DT weights (or scaling constants) reflect salience, range effects and scaling constants. Thus,

$$\text{weight}_{\text{DT}} = w \cdot r \cdot c.$$

While the multiplicative combination of the factors is mainly for convenience, there is some evidence in Shanteau and Anderson (1972) to suggest that when several factors influence weight, they do so multiplicatively.

The BDT approach leads to weights which depend on salience, range effects, scaling constants, and a variety of miscellaneous effects; the miscellaneous effects arise from the unknown influences of the direct rating procedure used by BDT. Altogether,

$$\text{weight}_{\text{BDT}} = w \cdot r \cdot c \cdot m.$$

A comparison of the DT and BDT weights reveals that the primary difference resides in the miscellaneous effects introduced by the BDT rating procedure.

PDT, as reflected by prospect theory, uses weights which reflect salience, scaling constants, and miscellaneous effects. In this case, the miscellaneous effects arise because of the influence of probability on decision weights. In total,

$$\text{weight}_{PDT} = w \cdot c \cdot m.$$

Again, the difference between this definition of weight and the preceding definition can be readily identified.

SJT, and related multiple-regression approaches, use statistically derived weights which reflect salience, range effects, scaling constants, and miscellaneous effects. The latter effects reflect the standardization procedure used to obtain regression weights. Thus,

$$\text{weight}_{SJT} = w \cdot r \cdot c \cdot m.$$

While this appears similar to BDT weights, the miscellaneous component is quite different in the two cases.

IIT, along with McClelland's (1980) extension of conjoint measurement, uses weights which incorporate salience, order, and miscellaneous effects. Probability (uncertainty) effects and source credibility are reflected in the miscellaneous category.

$$\text{weight}_{IIT} = w \cdot o \cdot m.$$

The difference between the weights for IIT and for other approaches is apparent. On the one hand, IIT weights reflect order effects and the other weights don't. On the other hand, the weights used by other approaches incorporate scaling constants and IIT doesn't.

Elaboration of scaling values. As argued above, definitions of weight cannot be presented in isolation from definitions of scaling value. Therefore, the complementary nature of scaling values will be considered here. Rather than presenting a step-by-step analysis of what is meant by scaling value for each approach, the results have been summarized in Table 1. In addition, the table contains summaries of the preceding discussion of weights. Finally, there is one additional column entry for variables that are undefined (or controlled) by each approach.

There may well be some justifiable differences of opinion about particular entries in Table 1, and there is certainly a need for additional analyses and reconsiderations. Nevertheless, Table 1 provides a useful starting point and summarizes what is presently known about weights and scaling values for different JDM approaches.

Table 1

List of Variables Influencing Weights and
Scaling Values for Each JDM Approach

Approach	Weight	Scaling Value	Undefined
DT	w, r, c	s, S, c, m	o
BDT	w, r, c, m	s, S, c, m	o
PDT	w, c, m	s, r, S	o
SJT	w, r, c, m	s, S, c	o
IIT	w, o, m	s, r	S, c

Key: w = salience
s = scale value
S = stimulus value
r = range effect
o = order effect
c = scaling constant
m = miscellaneous effects

Consequences of the Proposed Definition

A number of relevant consequences and predictions can be derived from the proposed definitions. First, it is noteworthy that the general framework expressed in Figure 1 not only satisfies the basic weight premises, but is apparently compatible with each of the JDM approaches. That is, Figure 1 demonstrates that it is possible to look at weight from a common theoretical perspective. Moreover, it suggests that this perspective can be examined in its own right independent of any particular JDM approach. As an example, the weighted averaging model is a key part of the weight definition. While there are pragmatic reasons for this (see the discussion of Equations 7 and 8), the averaging model has generally been uncritically accepted. Outside of tests conducted by Anderson for IIT (e.g., Anderson, 1974), there has been little effort given to validating the averaging model. Yet, if averaging is not appropriate, then all weight definitions would be on shaky grounds. If averaging does apply, then the weights are validated. Either way, it would be of utmost importance to establish the validity of the averaging model as a basis for JDM analysis.

Second, despite the ability of Figure 1 to provide a common conceptual framework, the various JDM approaches make use of strikingly different variables in defining weights. This can probably best be illustrated in the case of range effects. For DT, BDT, and SJT, range effects directly influence the estimates of weights (or scaling constants). While range effects are not clearly defined for prospect theory from PDT, these effects are apparently included in scaling/utility estimates. IIT is quite clear in incorporating range effects in scale values instead of weights. Overall, no two approaches define weight in exactly the same way. It is perhaps significant that all approaches have at least one undefined variable which is used to define weight or scaling value in another approach.

Third, with the exception of the w and s variables, there are no factors which are treated the same by all approaches. Thus, there appears to be considerable variation in the role played by any one factor. This is probably most notable in the case of probability information. Probability is handled in a variety of different ways: DT employs different utility measures depending on whether probabilities are present or not, BDT includes probabilities as a separate weighting factor, IIT and prospect theory from PDT incorporate probabilities into weights, and SJT apparently includes probability as a cue. Thus, probability is treated in some very divergent ways.

Fourth, as noted above, no approach provides a "pure" estimate of either weights or scaling values. That is, all approaches lead to definitions which are multiple-caused and hence should be subject to multiple-interpretations. Thus, it would appear that no approach has an a priori claim to superiority on the basis of purity. Therefore, as it probably should be, any choice among JDM approaches will have to be based on other considerations.

Multidimensionality of Weight

In almost all previous research, weights and scaling values have been treated as if they were single-dimensional concepts. That is, the estimated values have been presented as points on a single dimension. However, the preceding material should make it clear that neither weight nor scaling value can be characterized by a unidimensional conceptualization. While the use of a single-dimensional simplification may do little harm in any given study, the continued use may lead to some unfortunate side effects. For instance, researchers have tended to carry over single-dimensional concepts of weights from specific empirical studies to general conceptual/theoretical analyses. So that, based on narrowly-focused research, broad-based viewpoints have evolved which ignore the multidimensionality of weights.

This tendency to simplify a complex concept may help explain some of the past confusions between JDM approaches about the definition of weight. While almost all investigators agree about the intuitive definition of the weight concept, the procedures used by various approaches have looked at different facets of the concept. It's as if researchers were all using the same terminology to talk about weight, but in fact were defining and measuring different aspects of it.

There are two important implications of this observation. First, since each approach has defined and operationalized the weight concept differently, it is hardly surprising that there tends to be little communication about weight. Thus, even when similar research questions are asked about weight, the answers differ because the weight estimates are measuring different things. Second, there has been concern in the literature with trying to show that one approach is right and that the others are wrong when it comes to weights. According to the present view, however, there is no correct view since no approach offers a complete picture. In other words, each approach is a little right and a lot incomplete when it comes to talking about weights.

Multidimensionality of Scaling Value

While both weights and scaling values are multidimensional, further analysis suggests that the underlying source of the multidimensionality is different. Weights, on the one hand, can be considered to be multi-caused or multi-influenced, e.g., both salience and range effects can (depending on the definition used) contribute to weight. Scaling values, on the other hand, are multidimensional for two reasons. First, as discussed above, any given judgment problem will look at only one slice or dimension out of a multidimensional space, i.e., only a single dimension will be relevant. Second, scaling values are also multidimensional in another sense. Scaling values can be viewed as the end-product of a smaller-scale judgment process. That is, the values are in effect judgment themselves based on lower-level weights and scaling values. Thus, scaling values can be thought of as being the result of a hierarchical judgment system. Presumably, a set of basic values or underlying attitudes would lie at the core of this system. Therefore, while both weights and scaling values are multidimensional parameters, they have much different origins psychologically.

The preceding argument is by necessity based mostly on conjecture and relatively little on empirical evidence. This is because there has been very little research designed to explore the origins of scaling values. With some notable exceptions (Anderson & Lopes, 1974; Krantz, 1974; Ptacek & Shanteau, 1980), there seems to have been no systematic effort to examine the multidimensional nature of scaling values. One obvious suggestion for future research, therefore, is to study how scaling values are formed and how they relate to more basic attitudes and values. Such a study would be useful for two reasons: First, it may provide some answers to the question of what determines scaling values. As long as researchers take scaling values as a given, there will remain a void in our understanding of the judgment process. Second, such research may help resolve a long-standing question in psychology. Namely, are values or attitudes more or less permanent, or are they formed as the need arises? Research on the origins of scaling values may well prove of value in answering this question.

Discussion and Recommendations

Three issues will be addressed in this concluding section. First, some of the common criticisms and arguments against the use of weight will be considered. Second, several suggestions for clarifying the language of weights will be advanced. Finally, some research will be suggested which will go a long way towards testing the basic ideas advanced in this paper.

Criticisms of Weight

There have been basically three arguments offered against the psychological use of a weighting parameter.

Empty parameter. The first and most serious criticism is that weight is a concept without meaning or content. For instance, Schönemann, Cafferty, and Rotton (1973, p. 85) argue that "weights . . . are empirically empty parameters." They go on to state that weights "are redundant parameters, lacking empirical content." The basic argument offered by Schönemann et al. is that the averaging model is a special case of the basic additive conjoint measurement equation:

$$R_{ij} = a_i + b_j. \qquad (9)$$

In this case, the response, R_{ij}, is the sum of the component values, a_i

and b_j. This equation does not contain weights, and instead the component values can be viewed as a combination of weight and scaling value. Schönemann et al. correctly observe that weights cannot be uniquely determined from Equation 9, and so conclude that weights are meaningless. (While the paper by Schönemann et al. was presented as a commentary on Anderson's (1970) presentation of IIT, their comments are equally applicable to all JDM approaches.)

The solution to the uniqueness problem, as noted in the discussion of Equations 7 and 8, resides in the constraint on the sum of the weights. That is, when weights are constrained, they can be uniquely estimated. This has been pointed out repeatedly by adherents of IIT and related approaches (Anderson, 1973). More significantly, the averaging model with weights has recently been incorporated into a conjoint measurement framework (Luce, 1980; McClelland, 1980). Thus, it has been proven that weights are not empty parameters and that they can be uniquely estimated.

Of course, one could well ask whether weights are meaningful at a psychological level. However, there appears to be no serious advocate of the position that weights are psychologically empty. To the contrary, the problem appears to be that while almost psychologists accept the weight concept, they are often imprecise in using the concept (see the comments above on the implicit definitions of weight). Therefore, the consensus seems to be that weight is both a useful and a necessary concept.

Equal weights. The second criticism of weight accepts their existence, but argues that they don't matter; in the words of Wainer (1976, p. 213) they "don't make no nevermind." The argument is based on the observation that equal weights frequently do at least as well, if not better, than statistically estimated weights. Indeed, Dawes and Corrigan (1974) have shown that even randomly estimated weights can do better than human judges. The reason is that linear models in many situations are more statistically robust with equal weights than they are with subject-derived weights. That suggests that a superior fit can be obtained with all weight estimates set to unity. (It should be noted that both Wainer (1976) and Dawes and Corrigan (1974) were more concerned with the use of linear models for prediction than they were with evaluating JDM approaches. Nevertheless, their results have been interpreted to indicate that JDM analyses are insensitive to weights.)

If the weights used by JDM approaches are insensitive parameters, then perhaps the weighting concept should be eliminated, or at least de-emphasized. There are three reasons why this argument should not be accepted. First, many of the preconditions of the arguments about unit weighting in fact assume some differential knowledge about weights. Dawes and Corrigan, for instance, assume that only relevant variables are being considered. Yet, discriminating between relevant (non-zero weight) and irrelevant (zero weight) factors is the key step in many judgment tasks. In fact, the skill of experts is often tied to their ability to do just that (Shanteau & Gaeth, 1980; also see Troutman & Shanteau, 1977).

Therefore, differential weighting is a vital part of both the judgmental process and the unit weight argument.

Second, there turns out to be more situations than originally reported where differential weighting is important. For example, positive correlations between variables are assumed in most of the equal-weighting arguments. However, McClelland (1978) has recently demonstrated that equal weights are clearly inferior when variables are negatively correlated. Yet, in many real-world choice situations, negative (not positive) correlations are the rule. Thus, the original arguments appear to have been overgeneralized.

Third, differential weights have been shown repeatedly to be important in studies of learning and conflict resolution. While most of this research has involved the SJT approach (Hammond et al., 1975), the basic results have been replicated using other approaches (e.g., Norman, 1974, using IIT). Differential weight information forms the basis for what is termed "cognitive feedback"; and it is this form of feedback which is most useful in judgment studies (Hammond et al., 1975). In all, the equal-weighting position is at best a very weak base from which to argue against the weighting concept.

<u>Scaling constant</u>. The third criticism of weight acknowledges their validity and existance, but questions the ability to obtain uncontaminated measures of weight. The argument, put forth most clearly by Keeney and Raiffa (1976), is that scaling constants eclipse the ability of weight

estimates to be meaningfully interpreted. That is, such constants, which arise from the normalizing step in many weight estimation procedures, make any psychological interpretation impossible. Thus, "scaling constants do not indicate . . . relative importance" (Keeney & Raiffa, 1976, p. 273) because the effect of these constants is in general unknowable and uncontrollable.

Clearly this argument must be considered for any of the JDM approaches which have scaling constants in their weight estimates, e.g., DT, BDT, PDT, and SJT. However, not all approaches have scaling constants in their weight estimates, i.e., see IIT or conjoint measurement weights. Moreover, it is frequently possible by experimental means to eliminate any biasing influence that scaling constants may have on weight estimates. Thus, while these arguments are not without merit, they are not sufficient to eliminate consideration of weight as a psychologically and statistically meaningful parameter.

Language Clarification

Several recommendations can be made on the basis of the preceding analyses and comments. It should be clear that there is considerable need for a language cleanup. As illustrated in Table 1, too many different meanings can be attached to weight to allow for common communication. While it is too much to hope that any of the JDM approaches will change terminology, it would seem reasonable to encourage a greater degree of language specificity.

A good example of precise language is the use of "scaling constant" by DT to refer to its weighting parameter. An example of imprecise language is the use of "decision weight" by prospect theory from PDT; a better term would be "decision prospect weight" or simply "prospect weight." Similarly, both SJT and IIT make considerable use of the unmodified term "weight," although as seen in Table 1 the usage is quite different. For SJT, a preferable term might be "regression weight" or "lens model weight." For IIT, "integration weight" would be less confusing. Finally, for BDT which also tends to use the unmodified term "weight," a possible substitute would be "multiattribute weight" or even "importance weight" (which has occasionally been used in the BDT literature).

The purpose of such language revision would be to make clear the unique contribution of each approach. However, as long as approaches which have different definitions for weight continue to use the same term, there will be unavoidable confusions. It is worth noting that the language of scaling values is already much more distinguishable, and correspondingly there are many fewer language confusions. For instance, DT refers to "utility function," BDT talks about a "value curve," and prospect theory from PDT uses a "value function." Similarly, SJT refers to "function form" and IIT makes use of "scale value." This much more differentiated set of terms has resulted in a relatively confusion-free discussion of scaling/utility values. Hopefully, a comparable state of affairs can be obtained with some changes in weight terminology.

Another language recommendation is that a separate term be used when weight and scaling value are not separated. There are some instances, especially in conjoint measurement (see Schönemann et al., 1973), when it is not possible or not of interest to disentangle weight from scaling value. While occasionally phrases such as "nondecomposed values" have been used, there is as yet no commonly accepted term to deal with combined weight and scaling value. Therefore, the present recommendation is that "impact value" or simply "impact" be used to describe undecomposed value. This term has the advantage of being both specific and descriptive. In Figure 1, impact corresponds to the force around the fulcrum. Thus, impact has both a ready graphical as well as semantic interpretation.

Research Suggestion

One specific research project can be recommended as particularly worthwhile. This project would go a long way towards examining the ideas presented in this paper. Moreover, it would have the advantage of exemplifying the direction that further analyses might take.

There has been much discussion and contention between adherents of SJT and IIT as to the existence and role of range effects. As seen in Table 1, range effects show up in weights for SJT and in scaling values for IIT. What is proposed is an experiment to investigate the part that range effects play in the two approaches. To simplify the remaining discussion, only weight (w) and scaling value (s) will be considered in addition to range (r) effect. Also, only the SJT and IIT approaches will be discussed, although other approaches could be considered in any actual research. For present purposes, the differences between objective (S) and subjective (s) scaling values will be ignored.

To begin, the undecomposed impact value for both SJT and IIT would presumably be $w \cdot r \cdot s$. However, the two approaches differ on how to group the range effect. SJT groups range with weight, whereas IIT groups range with scaling value. In short, the following distinction applies:

$$\text{Impact} = w \cdot r \cdot s \qquad (10a)$$
$$\text{SJT} = (w \cdot r) \cdot s \qquad (10b)$$
$$\text{IIT} = w \cdot (r \cdot s) \qquad (10c)$$

Among other implications, this suggests that neither SJT nor IIT provides a complete decomposition of impact value. That is, any debate as to which approach provides a superior definition is misplaced, since neither leads to a complete breakdown. (There may, of course, be strong arguments for the desirability of a particular approach on other grounds.)

If this analysis is appropriate, then it should be possible to experimentally disentangle the three components. What is needed is a research study which independently manipulates weight, scaling, and range variables. The first prediction is that these three variables should combine interactively for actual judgments. Moreover, the interaction should be concentrated in the trilinear (linear x linear x linear) component of the interaction; see Shanteau (1977) for further discussion of this test.

If these predictions are confirmed, then it would establish that the three-way description of impact in Equation 10a is appropriate. It would also show that range effects can be separated from weight and scaling values. On the other hand, if range effects cannot be separated from, say, scaling value, then it would suggest that the original IIT formation in Equation 10c is correct; i.e., range effects should in fact be combined with scaling value. Another possibility, of course, is that range may have little, if any, effect at all.

Besides conducting tests of the combination process, an additional advantage of the proposed research is that a more detailed examination of range effects would result. Such effects have been frequently discussed, but have not been systematically analyzed in judgment research (although see John & Edwards, 1978).

Research of this sort could also be used to clarify the effects of the other factors in Table 1. That is, the same paradigm can be applied to study each factor in turn. In addition, combinations of factors or unexamined factors (e.g., sequential vs. simultaneous presentation) can be examined in the same way. Through such research, a clearer picture of what influences or constitutes weight (and scaling value) should emerge.

Footnote

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