10. SOCIAL JUDGMENT THEORY

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WHY IS JUDGMENT REQUIRED?

Knowledge of the environment is difficult to acquire because of causal ambiguity—because of the probabilistic, entangled relations among environmental variables. Tolman and Brunswik called attention to the critical role of causal ambiguity in their article "The Organism and the Causal Texture of the Environment" (1935), in which they emphasized the fact that the organism in its normal intercourse with its environment must cope with numerous, interdependent, multiformal relations among variables which are partly relevant and partly irrelevant to its purpose, which carry only a limited amount of dependability, and which are organized in a variety of ways. The problem for the organism, therefore, is to know its environment under these complex circumstances. In the effort to do so, the organism brings a variety of processes (generally labeled cognitive), such as perception, learning, and thinking, to bear on the problem of reducing causal ambiguity. As a part of this effort, human beings often attempt to manipulate variables (by experiments, for example) and sometimes succeed—in such a manner as to eliminate ambiguity. But when the variables in question cannot be manipulated, human beings must use their cognitive resources unaided by manipulation or experiment. They must do the best they can by passive rather than active means to arrive at a conclusion regarding a state of affairs clouded by causal ambiguity. They must, in short, exercise their judgment. Human judgment is a cognitive activity of last resort.

It may seem odd to remind the readers of this volume of the circumstances which require human judgment, yet it is essential that we do so, for it is precisely these circumstances which are so often omitted from studies of human judgment. If we are to understand how human beings cope with judgment tasks, however, not only must such ambiguity be present in the conditions under which human judgment is studied, but causal ambiguity must itself be represented within the framework of a theory of human judgment (Brunswik, 1952, 1956; Hammond, 1955).

BASIC CONCEPTS

RELATIONSHIPS: THE FUNDAMENTAL UNITS OF COGNITION

The fundamental concept ordinarily employed to describe an environmental "input" to the organism is the stimulus. That concept is rejected here. Although both Tolman and Brunswik used this term, they did not make a complete conceptual commitment to it; both argued that the objects and events...
acquire because of the organism's context, entangled in nature of the organism's environment and Brunswik's ambiguity in the nature of the organism's environment. The fact that the organism (and Brunswik's ambiguity in the nature of the organism's environment) can be seen as neither a sign nor a stimulus (as Brunswik, 1955, p. 5) implies that the organism's environment is not a simple stimulus-response relationship. Instead, the organism's environment is a complex system of stimuli and responses, each of which can have multiple meanings and implications for the organism. This is why Brunswik (1955) insisted that the organism's environment must be analyzed as a complex system of stimuli and responses, and not simply as a set of simple stimulus-response relationships.

Brunswik's (1955) concept of the organism's environment as a complex system of stimuli and responses has important implications for the study of human judgment and decision making. It suggests that the organism's environment is not a simple stimulus-response relationship, but rather a complex system of stimuli and responses, each of which can have multiple meanings and implications for the organism. This is why Brunswik (1955) insisted that the organism's environment must be analyzed as a complex system of stimuli and responses, and not simply as a set of simple stimulus-response relationships.
PRINCIPLE OF PARALLEL CONCEPTS

As can be seen in the above quotation, Brunswik indicated that organismic and environmental systems should be described in symmetrical terms. That symmetry is represented in what Brunswik called the "lens model" of behavior indicated in Figure 1. (Space does not permit more than a cursory reference to the conceptual implications of the lens model; the best of several original sources is Brunswik's "The Conceptual Framework of Psychology," 1952; a secondary source which presents part of what is contained in several original articles is Hammond's The Psychology of Egon Brunswik, 1966.)

![Achievement (A)]

![Criterion (C)]

![Validity (V)]

![Cue Utilization (U)]

Fig. 1. Brunswik's lens model.

As Brunswik describes the lens model, it becomes clear that he employs a principle of parallel concepts, for each concept on one side is paralleled by a similar concept on the other. Thus, cues on the task, or ecological, side vary in ecological validity, and on the organismic side there is variation in cue utilization by the subject. And just as the relations between cues and distal variables on the ecological side may assume various (linear, curvilinear) forms, according to the principle of parallel concepts, the relations between cues and judgments may also assume various function forms on the organismic side. The investigator has similar interests with regard to both sets of variables: to what extent ecological validities are matched by cue utilization and to what extent ecological function forms are matched by subjective function forms. Social judgment theorists are also concerned with the extent to which the principles of organism reflected in the psychological system of the organism, and it is this that Social Judgment theorists apply to task situations.

DISTINCTION BETWEEN PROXIMAL-DISTAL AND SENSIBLE-SUBLATIVE

This distinction is critical to any theory of judgment. For example, if a surface is presented (in the judgment task) and the cues, this distal system (see Figure 1) raises the question of what relation between them we have named it the Zone of Ambiguity.

The region between the proximal and distal effect (surface) is a region defined by the relations between the cue and the effect. It is produced because the cue is not a direct measure of the effect but is related to the effect through intermediate variables. The intermediate variables may be of the type of principle of causality, or they may be of the type of circumstance giving rise to the effect. In short, causal relations of the intermediate variables seem to affect the judgment.

The results of the experiment show that the extent to which the judgment is influenced by the cues is determined by the relation between the cue and the effect. Therefore, it is the relation between the cue and the effect that is the critical factor in determining the extent to which the judgment is influenced by the cues. This is demonstrated by the fact that the results of the experiment show that the extent to which the judgment is influenced by the cues is determined by the relation between the cue and the effect.
principles of organization that control the task system are reflected in the principles of organization that control the cognitive system of the subject.

It is the principle of parallel concepts, therefore, that produces the symmetrical relation between the descriptive terms applied to the organismic system and to the environmental system, and it is this principle that is responsible for the fact that Social Judgment Theory (SJT) includes a set of concepts which apply to task systems as well as person systems.

DISTINCTION BETWEEN SURFACE AND DEPTH

This distinction is essential to SJT. It derives from the proximal-distal separation in perception theory and thus refers to the separation between what is given and what is inferred. Surface data are (given) cues to (inferred) depth conditions in the judgment task. By virtue of the principle of parallel concepts, this distinction also applies to organismic judgment systems (see Figure 1). Separation of surface and depth is critical to any theory of judgment (or inference), for it raises the question of the properties of the region that intervenes between them. Because of the importance of this region, we have named it the "zone of ambiguity".

The Zone of Ambiguity

The region between depth and surface variables in a given judgment task involves the relations between cause (depth) and effect (surface). Because a single effect may be produced by several causes, as well as because multiple effects may be produced by a single cause, there is ambiguity from cause to effect and effect to cause. Because causes may be related, and because effects are interrelated, the network of task relations can be said to be entangled. Moreover, causal ambiguity is produced because (1) surface data are less than perfectly related to depth variables, (2) functional relations between surface and depth variables may assume a variety of forms (linear, curvilinear), and (3) the relations between surface and depth may be organized (or combined) according to a variety of principles (for example, additivity or pattern). These circumstances give more specific meaning to the term "causal texture," or causal ambiguity.

In short, causal ambiguity within the zone of ambiguity is the source of the human judgment problem, as well as a source of the misunderstandings and disputes that occur when judgments differ. As we shall see below, social judgment theorists direct themselves to reducing causal ambiguity in judgment tasks.
and in judgment policies by *externalizing* the properties of the zone of ambiguity in both systems.

**OBJECTIVES OF SOCIAL JUDGMENT THEORY**

So far, we have set forth our assumptions about the environmental circumstances that create the need for human judgment. In addition, we have indicated the major concepts which SJT employs in the effort to understand the judgment process that must cope with these circumstances. The reader will have observed that these assumptions and concepts differ in fundamental ways from those offered by other theorists; he should also know that our research objectives differ rather markedly from those of other judgment theorists.

1. SJT is intended to be life relevant; that objective is a direct legacy from Brunswik.
2. SJT is not a law-seeking theory. It is not aimed at finding the laws of human judgment; rather, it is intended to be descriptive.
3. Social judgment theorists are interested in creating cognitive aids for human judgment—particularly for those persons who must exercise their judgment in the effort to formulate social policy and who will ordinarily find themselves embroiled in bitter dispute as they do so. Social judgment theorists intend not only to understand human judgment but to create and develop ways of improving it.

These objectives have led us to study disputes arising from differing judgments, and this research has in turn led us to invent a cognitive aid for persons involved in such disputes. More specifically, the theory described above, together with the results of empirical research, indicated that in order to be effective, a cognitive aid for persons exercising their judgment should be capable of *displaying pictorially* the weights, function forms, and uncertainty in persons' judgment policies as well as in judgment tasks. Without such displays, persons involved in dispute, or interpersonal learning, can do little besides exchange incomplete, inaccurate information about their judgment policies; verbal explanations of their introspections regarding their judgment processes are their only recourse. Social judgment theorists, on the other hand, can now offer persons the use of interactive computer graphics terminals which will display for them pictorial representations of their judgment policies, as well as the properties of task systems. These procedures have been developed from the quantitative method employed by social judgment theorists, a topic to which we now turn.

**QUANTITATIVE METHOD**

**ANALYSIS OF THE**

The analysis in four steps:

1. **Identification** and formal properties.
2. **Exercise** about a representation.
3. **Analysis** of displayed graphic active computer.
4. **Description** of the
table.

**Identification of the**

This step completes, which the judgment properties (for a range of the dimensions used in the judgment problem) scale study into analysis could be designed to elicit. Since met (and investigated) however, since a proper identification is particular fied, since it is stage will be de 1974, who shows success can be ascertained.

**Exercise of Judgment**

A judgment task, cases represented of a profile rep
QUANTITATIVE METHOD

ANALYSIS OF THE COGNITIVE SYSTEM OF AN INDIVIDUAL

The analysis of an individual's cognitive system proceeds in four steps:

1. Identification of the judgment problem. The substantive and formal properties of the judgment problem are identified.
2. Exercise of judgment. The individual makes judgments about a representative set of cases of the judgment problem.
3. Analysis of judgment. The individual's judgments are analyzed to determine the components of his cognitive system.
4. Display of results. The results of the analysis are displayed graphically to the individual (ordinarily by interactive computer graphics techniques).

DESCRIPTION OF THE REGRESSION ANALYSIS APPROACH

Identification of the Judgment Problem

This step consists of three parts: (1) defining the judgment to be made, (2) identifying the information (cues) on which the judgment is based, and (3) discovering the formal properties (for example, intercorrelations, distributions, and ranges) of the set of cue variables in the task. The procedures used in this critical step vary according to the type of judgment problem and the purpose of the analysis. A full-scale study involving extensive data gathering and multivariate analysis could be conducted, or a simple guided interview designed to elicit cue variables from the individual might suffice. Since methods used in this step are highly situation (and investigator) specific, we shall not attempt to describe them further here. This step is critical for the analysis, however, since the validity of all that follows depends on the proper identification of the judgment problem at this step. It is particularly important that all major cues are identified, since it is unlikely that the omission of a cue at this stage will be detected in later analysis. (But see Stenson, 1974, who shows that certain parameters of the judgment process can be ascertained even though the cues are not identified.)

Exercise of Judgment

A judgment task is generated that consists of a number of cases representing the judgment problem. Each case consists of a profile representing a different combination or mix of
values on the several cues. The individual indicates his judgments by rating several profiles on a numerical scale.

The judgment task may be conducted by pencil-and-paper procedures or by an interactive computer terminal, but the cue information must be presented unambiguously. All possible perceptual confusion must be eliminated from the display so that the task will be wholly judgmental in nature (unless, of course, the investigator is interested in studying the effects of perceptual ambiguity).

The formal properties of the judgment task (for example, distributions and interrelations) should correspond to the properties of the environment that gave rise to the problem. The correspondence of the judgment tasks to the environment (representativeness) is essential if the results of the analysis of the judgment task are to be generalizable.

Analysis of Judgment

The judgment data are analyzed in terms of multiple regression statistics. The values of the cues are the independent variables in the analysis, and the individual's judgments constitute the dependent variable. The linear model that is fitted by this technique is

$$y_{ij} = \sum_{k=1}^{m} b_{jk} x_{jk} + \alpha_i + e_{ij},$$

where $y_{ij}$ is the judgment of individual $i$ for profile $j$, $m$ is the number of cues, $b_{jk}$ is the raw score regression weight for individual $i$ on cue $k$, $x_{jk}$ is the value of cue $k$ on profile $j$, $\alpha_i$ is the constant term for individual $i$, and $e_{ij}$ is the residual error from the model of individual $i$ for profile $j$.

Cognitive Control and Consistency

Hammond and Summers (1972) distinguished between knowledge and cognitive control. But recent research (to be described below) has shown that cognitive control must also be distinguished from cognitive consistency. "Control" refers to the similarity between an individual's judgments and predictions based on a specific model; "consistency" refers to the similarity between repeated judgments of identical profiles.

This distinction can be clarified by noting that when a person makes numerous repeated judgments of the same profile, they will be distributed about their mean, $\bar{Y}$, and the variation of those judgments about $\bar{Y}$ is due to the individual's inconsistency. If the predicted judgments of profile $j$ based on two models (A and B) and the repeated judgments are of the judgment control with respect to any other point, the model coincidence with respect to any model is then equal to be lower than consistency.

Measures of Control

Control is measured of a set of profiles, the multiple correlation coefficient, because it measures judgments and predictions.

Consistency is measured by repeated judgments about the best estimate of the specific model (see, for example, Table I) helps the investigation of all of an individual's judgment. If the model, then the model is well as control. It measures only the consistency of predictions with respect to the model consistency can then be calculated as

$$\hat{\sigma}^2 = \frac{\sum_{i=1}^{n} (y_{ij} - \bar{y})^2}{n - p},$$

where $\hat{\sigma}^2$ is the estimate of the mean squares, $y_{ij}$ and $\bar{y}$ based on profile $j$ and the total number of repeated judgments.
on two models (A and B) are $\hat{Y}_{Aj}^*$ and $\hat{Y}_{Bj}^*$, then the variation of the repeated judgments about $\hat{Y}_{Aj}^*$ indicates the individual's control with respect to model A on the $j$th profile. The variation of the judgments about $\hat{Y}_{Bj}^*$ indicates the individual's control with respect to model B on the $j$th profile. Since the variance about the mean is always less than the variance around any other point, consistency is the upper bound for control with respect to any model. Note that when the predictions from a model coincide with the mean of the distributions of judgments (for example, if $\bar{Y}_j = \hat{Y}_{Aj}^*$), control (with respect to that model) is then equal to consistency. Otherwise, control will be lower than consistency.

Measures of Control and Consistency

Control is measured by estimating the variation of judgments of a set of profiles about predictions produced by a model. The multiple correlation ($R$) provides a measure of control because it measures the correspondence between an individual's judgments and predictions from a specific model.

Consistency is measured by estimating the variation of repeated judgments about their mean. In order to help select the best estimate of this variation, a test for lack of fit of the specific model under consideration should be performed (see, for example, Draper & Smith, 1966, pp. 26-31). This test helps the investigator decide whether the model he is using accounts for all of the consistent variation in the individual's judgment. If there is no evidence of lack of fit of the model, then the $R$ provides a measure of consistency as well as control. If there is evidence of lack of fit, then $R$ measures only the correspondence between a person's judgments and predictions generated by the model—that is, control with respect to the model used by the investigator. A measure of consistency can then be obtained as follows.

First, a measure of pure error is computed:

$$
\sigma^2 = \frac{1}{p} \sum_{i=1}^{P} \frac{1}{2} (y_{ij} - \hat{y}_{ij})^2
$$

where $\sigma^2$ is the estimate of pure error in the individual's judgments, $y_{ij}$ and $\hat{y}_{ij}$ are two judgments made by individual $i$ based on profile $j$ on two different occasions, and $p$ is the total number of repeated profiles.
This pure error measure is the variance of the differences between the repeated judgments on each profile and their mean. (For a formula that applies when judgments are repeated more than once, see Draper & Smith, 1966, p. 29.) It will be large if there tends to be a large difference between judgments of the same profile made at different times, and it will be small if judgments made at different times are very similar. The pure error measure can be regarded as an indication of the inconsistency in an individual's judgments.

The pure error measure is then used to compute consistency as follows:

\[
\text{Consistency} = \sqrt{\frac{\text{consistent variation}}{\text{total variation}}} = \sqrt{\frac{s_y^2 - s^2}{s_y^2}} = R_0,
\]

where \(s_y^2\) is the variance of an individual's judgments. This measure, which we shall call \(R_0\), is similar to the intraclass correlation which can be considered an estimate of the upper bound for control with respect to any polynomial regression model (see Winer, 1971, pp. 389-391).

\(R_0\) is proposed as a measure of consistency of an individual's judgment here for the first time. Its properties when used in the context of the study of human judgment are unknown. It will be influenced by the variation in the cues, the cue intercorrelations, the number of repeated profiles, and other task properties. The exact nature of these effects remains a topic for future research.

Nonlinear Models

The linear regression model has been applied to a variety of judgment problems and has proved useful in many cases (see Slovic & Lichtenstein, 1973, for a review). Moreover, the conceptual simplicity and descriptive power of the linear model make it an important tool for social judgment theorists. (See Dawes & Corrigan, 1974, for an important discussion of the use of the linear model in decision making.)

The analysis is not limited to the linear model, however, for although a linear model is used for the initial fit, it is critically evaluated by the following criteria before being accepted as a representation of a cognitive system:

1. Is the linear representation useful? This depends on the purpose of the analysis—task learning, interpersonal learning, or conflict resolution.
2. Is there evidence of significant bias from the test for lack of fit of the model? If the repeated judgments necessary for the lack-of-fit test are not available, then a low $R$ signals possible danger in accepting the linear model (although a low $R$ in itself does not mean that the linear model must necessarily be rejected, just as a high $R$ does not mean that the linear model must necessarily be accepted).

3. Is nonlinear variation shared among individuals? This is determined by computing correlations among the residuals ($e_{ij}$) for a number of individuals. (These correlations are the $C$ coefficients in the lens model equation to be discussed below.) A high correlation between the residuals for two individuals suggests that the residuals contain reliable judgmental variation which might be identified by a nonlinear model.

If any of the above conditions exists, nonlinear models of judgment must be investigated. A nonlinear (additive) model that has been found useful in several studies is the polynomial model formed by adding squared terms to Eq. (1),

$$y_{ij} = \sum_{k=1}^{m} (b_{ik}x_{ijk} + b_{i}(k+m)z_{jk}) + c_i + e_{ij},$$

(2)

where $b_{i}(k+m)$ is the regression weight for the square of the value of cue $k$. This model is additive because the contribution of any cue is independent of the values of the other cues, yet it will represent the nonlinear (U- and inverted U-shaped) function forms or any cue-judgment function that can be approximated by some portion of a parabola.

A problem encountered in using Eq. (2) is that the weight and function form components are combined. For clarity of description of the judgment system (later) in Step 4, weight and function form should be separated. This separation can be accomplished by algebraic manipulation of Eq. (2).

We begin by defining a function of $x_{jk}$ which is the sum of the linear and nonlinear terms involving $x_{jk}$ in Eq. (2):

$$f_{jk}(x_{jk}) = b_{i}x_{jk} + b_{i}(k+m)x_{jk}. $$

We further define $f_{j_{max}}$ as the maximum value of $f_{jk}$ over the range of cue $k$, $f_{j_{min}}$ as the minimum value of $f_{jk}$ over the range of cue $k$, $y_{max}$ as the maximum allowable judgment, and $y_{min}$ as the minimum allowable judgment:
\[
g_k = \frac{y_{\text{max}} - y_{\text{min}}}{f_{\text{max}} - f_{\text{min}}} \\
h_k = y_{\text{min}} - g_k f_{\text{min}} \\
f_k(x, j_k) = g_k f_{k'}(x, j_k) + h_k
\]

Thus, \( f_k \) will range from \( y_{\text{min}} \) to \( y_{\text{max}} \). If \( f_k \)'s are formed in this way for all cues, then Eq. (2) can be rewritten as

\[
y_{ij} = \sum_{k=1}^{m} \left( \frac{1}{g_k} f_k(x, j_k) - \sum_{k=1}^{m} h_k + c_i + e_{ij} \right) = \sum_{k=1}^{m} \omega_k f_k(x, j_k) + c_i + e_{ij}
\]

where

\[
\omega_k = \frac{1}{g_k}
\]

and

\[
c_i^* = c_i - \sum_{k=1}^{m} h_k.
\]

This equation separates weight (\( \omega_k \)) from function form (\( f_k^* \)) so that there will be one weight for each cue and the cue weights are applied to function forms all having common ranges.

Equation (3) represents only one of the possible methods for separating weight from function form. An alternative would be to rescale the \( f_k \) by standardizing to obtain \( f_k^* \) with zero mean and unit variance and then to calculate \( \omega_k \) based on the standardized \( f_k^* \). All methods for separating weight and function form would result in algebraically equivalent models when applied to a given sample because they could all be derived from Eq. (2). The selection among several algebraically equivalent models must be made on the basis of the usefulness and clarity of the representation provided by each model.

The method used to derive Eq. (3) (called the "range" method) is useful because whenever the range of each cue is known (as is often the case), the method is independent of any particular sample of cue values. This is true because no sample cue values are involved in the computation of \( f_k^* \) or \( \omega_k \). Independence of the sample of cue values is important because identical forms of Eq. (2) derived from two different samples of cue profiles will yield identical forms of Eq. (3). This would not necessarily be true for subject forms (see below for function forms, \( \omega_k \)).

Although the dependent of a pay being dependent on a subject's relative dispersions of more cues or obtaining may be other methods property might be useful, the exploration be limited to the additiveness of cues. The procedures for an additive model may be examined for utility of multiple cues that such as the cross-validated. Tempted to invest regression framework.

Finally, it is a significant that the pensive models and the influence of a subject's judgments leads to judgment theories. Modeling the judgments or judgment theorists item to be a step rather than a complete. Theorists should be as a cognitive and in managing conflict.
would not necessarily occur with the standardization method, however. The property of independence is particularly critical for subject-controlled revision of weights and function forms (see below). When an individual is revising weights and function forms, he is, in effect, specifying the form of Eq. (3), which must, in turn, be translated into the form of Eq. (2) for application to a set of profiles. The judgment resulting from the application of specified weights and function forms to a particular profile should not depend on which other profiles happen to occur in the sample, which would be the case with the standardization method.

Although the range method has the advantage of being independent of a particular sample, it has the disadvantage of being dependent on the known ranges of the cues. This is not a serious disadvantage if the ranges accurately reflect the relative dispersions of the cues; however, if the ranges of one or more cues are determined by a few extreme cases, the weights obtained may be invalid or misleading. In such cases, an alternate method may be preferred even though the independence property might have to be relinquished.

The exploration of higher-order regression models need not be limited to the model including squared terms or to the additive model. Rules which are nonadditive with respect to the cues may be examined. For example, Einhorn (1970) describes procedures for analyzing conjunctive and disjunctive noncompensatory models. A variety of nonlinear models that are nonadditive with respect to the cues can be investigated with the use of multiple regression analysis. It is important, however, that such examinations be guided by theory and reasonable hypotheses about the judgment problem and that all models be cross-validated. Slovic and Lichtenstein (1973) discuss attempts to investigate nonlinear judgmental models within the regression framework.

Finally, it should be noted that there is a growing recognition on the part of all judgment researchers that many different models will frequently provide equally high predictability of a subject's judgments (Goldberg, 1971). In fact, the case which sharply differentiates the predictability of different models is something of a rarity. This embarrassment of riches leads to an important difference between social judgment theorists and other investigators interested in modeling the judgment process. The difference is that social judgment theorists consider the analysis of the cognitive system to be a step in a process designed to aid the individual rather than a competition among models. The social judgment theorist should therefore select the model which is most useful as a cognitive aid for helping an individual learn, or for managing conflict, say, even if the most accurate
model accounts for somewhat less variance than some simpler model. But if the simpler model misleads because, for example, it does not account for judgmental variation which is crucial for clarifying reasons for conflict, then the simpler model must, of course, be rejected. As a result of this perspective, the social judgment theorist places less emphasis on mathematical precision in cognitive modeling and more emphasis on empirically demonstrating the usefulness of a given model with regard to a given problem, as noted above (see also Hoffman, 1960).

Display of Results

The weights and function forms obtained from the analysis of judgment are presented to the individual immediately following his judgments by means of computer graphic displays. An example of a pictorial display of weights and function forms generated by a computer program is presented in Figure 2. In many applications it is necessary to compare two or more systems (an individual's cognitive system and a task system, or the cognitive systems of two or more individuals). A computer-generated pictorial display comparing two systems is shown in Figure 3.

Fig. 2. An example of a computer graphic display of weights and function forms.

Fig. 3. A comp.
The steps described above have been used with success in numerous studies of cognitive process and will continue to be important in future work. The availability of interactive computer graphics devices, however, provides flexibility and power for the analysis of cognitive systems far beyond what has been previously available. Some of the most promising new procedures are (1) subject-controlled revision of weights and function forms, (2) use of hierarchical judgment models, and (3) multimethod, multistage analyses. All of these are now being investigated; each will be briefly described below.

Subject-Controlled Revision of Weights and Function Forms (at the Computer Console)

If the individual wishes to change the weights and function forms in his judgment policy, he can do so by use of a light pen or by entering new weights and function forms directly from the keyboard. The computer can generate judgments consistent with the model newly specified by the individual and display to him these new judgments in response to a set of profiles. The individual can then review the judgments which were derived from the weights and function forms he specified and can revise his judgment policy (for example, his weights and/or function forms) again if he is not satisfied with the new judgments. Thus, the computer provides the individual with
complete control over his cognitive system during the exercise of his judgment. The development of this procedure as an aid for the person exercising his judgment illustrates clearly the sharp difference in research aims between social judgment theorists and other judgment researchers who focus their efforts on the search for the correct model of judgment processes.

**Hierarchical Judgment Models**

In many cases the cues for a judgment may in fact be judgments themselves. Many, if not most, judgment problems can be described by a single set of cues and judgments only when the researcher demands that the subject limit his cognitive activity in this way. In fact, many, perhaps most, judgment problems must be structured as multilevel hierarchical systems if any sense is to be made from their analysis (a point made quite early by Hammond, Hursch, & Todd, 1964). Under certain conditions, such hierarchical problems can be divided into numerous simple judgment problems, each of which can be analyzed separately. The use of interactive computing makes possible the structuring of the hierarchical problem, the analyses of the subproblems, and the recombining of the subproblems into the hierarchical system. Thus, highly complex judgment problems can be studied by dividing them into manageable subproblems by means of interactive computer graphics. (See Smith, 1973, for a description of this process.)

**Multimethod Analyses**

The exploration of an individual's complete cognitive system requires more than the traditional analysis of a single judgment task. Moreover, when cues are highly intercorrelated, as they will be in representative judgment tasks, the results of the single task analysis are ambiguous because the weights cannot be strictly interpreted (Darlington, 1968), and as a result, the description of the cognitive system can be misleading. To cope with this problem, several tasks are employed in order to provide a multistage analysis of the judgment process. The tasks are constructed in order to remove the ambiguity that results from the use of a single task. Two ways of deriving such tasks are described here.

**Predicting Each Cue from the Others**

Each cue in turn is considered a judgment to be made from the other cues. The analysis of the resulting tasks will clarify the individual's organization of the cues and the intersubstitutability set of cues to be selected.

**Successive Omission**

Each cue in turn that the individual subset of the original intersubstitutability determination of Brunswik, 1956, promotes omission.

Numerous variant examples, cue cue completely omitted confidence judgments prove useful. Dis data is beyond the see Hammond, Kern, (1959, pp. 326-339) intutions in cue theorists' ratings of.

The multimethod system can be accurately, and, indeed, feasible ones by a probability of this to analyze a variety of particular problem, by social judgment thoroughly develop although this complex 50-minute, one human judgment, it escape from detail judgment theorists of human judgment.

**EXTENSIONS OF THE COGNITIVE SYSTEMS**

**The Lens Model Equations**

The models described a basis for analyzing original lens models. The two systems was proposed and modified by Tu-
interstitutability properties which will permit one cue or set of cues to be substituted for another.

Successive Omission

Each cue in turn is omitted from the judgment problem so that the individual is forced to make his judgment based on a subset of the original cues. This method further explores the interstitutability properties of the cues and also permits determination of the unique contribution of each cue. (See Brunswik, 1956, pp. 24, 25, 57, 63, for a discussion of "successive omission."

Numerous variations on these methods are possible. For example, a cue could be restricted in range rather than being completely omitted. Other methods, such as those utilizing confidence judgments or cue-consistency judgments may also prove useful. Discussion of the analysis of such multimethod data is beyond the scope of this paper. For a useful example, see Hammond, Kern, Crow, Githens, Groesbeck, Gyr, and Saunders (1959, pp. 526-539) who made use of naturally occurring variations in cue distributions to ascertain cue weights of physicians' ratings of medical students.

The multimethod procedure for the exploration of a cognitive system can be accomplished by use of computer graphics procedures, and, indeed, these procedures appear to be the only feasible ones by which to pursue this problem, for the flexibility of this technology makes it possible to formulate and analyze a variety of tasks according to the demands of a particular problem. This procedure has not yet been widely used by social judgment theorists, but as the methods become more thoroughly developed and tested, its use will increase. And although this complex procedure seems a far cry from the simple 50-minute, one-shot experiments currently employed to study human judgment, it seems unlikely that there will be an easy escape from detailed, multimethod, multistage analyses if judgment theorists wish to come to grips with the full range of human judgment.

EXTENSIONS OF THE METHOD: ANALYSIS OF THE RELATION BETWEEN COGNITIVE SYSTEMS

The Lens Model Equation

The models describing two or more cognitive systems provide a basis for analyzing the relation between the systems. The original lens model equation for analyzing the relation between two systems was proposed by Hursch, Hammond, and Hursch (1964) and modified by Tucker (1964). Additional formulations have
been developed by Castellan (1972) for dealing with multiple judgments and multiple criteria, Stewart (1974) for separating the effects of different types of variation, and Lindell (1974) for analyzing the components of accuracy as measured by the sum of squared differences between raw scores. The formulation of Tucker (1964) has been the most widely used by social judgment theorists and will be discussed here.

The Tucker formulation is

$$ r_a = GR_1 R_2 + C \sqrt{1 - R_1^2} \sqrt{1 - R_2^2}, $$

(4)

where $r_a$ is the correlation between two variables $Y_1$ and $Y_2$ (the variables may be two individuals' judgments—agreement—or an individual's judgment and an environmental criterion—achievement); $G$ is the correlation between the components of $Y_1$ and $Y_2$ that are predicted from a linear regression on the cues; $R_1$ and $R_2$ are the linear multiple correlations between the cues and $Y_1$ and $Y_2$, respectively; and $C$ is the correlation between the residuals from the linear regressions of $Y_1$ and $Y_2$.

The indices $R$, $G$, and $C$ can be interpreted as follows:

1. $R$ is a measure of the fit of a specific model. If it is a model of the environment, then $R$ represents the maximum predictability possible (assuming the correct model). If it is a model of an individual's cognitive system, then $R$ can be considered a measure of cognitive control with respect to that particular model (Hammond & Summers, 1972). In most studies to date, $R$ refers to the fit of a linear multiple regression model; however, the lens model equation is equally appropriate if the model includes nonlinear functions of the cues (see Stewart, 1974).

2. $G$ is the correlation between predictions based on two models. In a learning situation in which one model represents an individual and the other represents a task, $G$ is the achievement that would result if both the person model and the task model were executed with perfect control. If both models are of individuals, then $G$ is the agreement that would result from the perfectly consistent application of both models. Since $G$ and $R$ are statistically independent, they provide a means of separating the effects of differences in models from the effects of the control exercised over the application of those models.

In a task-learning situation, $G$ can be considered a measure of knowledge about the task because $G$ measures the correspondence between the model of the person's cognitive system and the model of the task system. If we ignore the second term on the right of Eq. (4), we have

$$ r_a = GR_1 R_2, $$

(5)

This equation is only when knowledge

3. $C$ measures $Y_2$ that is not the regression and $C$ value indicates that is shared by value indicates the regression and positive

model.

A low $C$ value (consistent nonlinear of shared nonlinear contain consistent

For more detail model equation, see

Cluster Analysis

In the case in which individuals have been discovered within the group with the discovery of how the cognitive system is used to classify similar with respect

Any clustering similarity between

to cluster or

We will briefly discuss algorithms that are

Wherry & Naylor, 1972, based on judgment

Similarity between

The correlation between individuals over the sum similarity between that no models of
or

\[ \text{Performance} = \text{knowledge} \times \]
\[ \text{cognitive control} \times \text{task control}. \]

This equation indicates that maximum performance is realized only when knowledge and control are maximized.

3. \( C \) measures the relation between the components of \( Y_1 \) and \( Y_2 \) that is not accounted for by the regression analysis. If the regression analysis is based on a linear model, then a high \( C \) value indicates that there is consistent nonlinear variation that is shared by the two systems. The presence of a high \( C \) value indicates the need for an examination of the original regression and possible inclusion of nonlinear terms in the model.

A low \( C \) value does not necessarily indicate the absence of consistent nonlinear variation; it only indicates the absence of \textit{shared} nonlinear variation. Either system may separately contain consistent nonlinear components even when \( C \) is low.

For more detailed discussions of properties of the lens model equation, see Castellan (1973) and Stewart (1974).

\textbf{Cluster Analysis}

In the case in which the cognitive systems of a group of individuals have been analyzed, there are usually subgroups within the group who have similar judgmental systems. The discovery of such subgroups will simplify the description of the cognitive systems of the group and will identify factions within the group that are likely to conflict. Cluster analysis is used to classify members of a group into subgroups that are similar with respect to their judgments.

Any clustering procedure requires measures of distance or similarity between objects to be clustered and uses some algorithm to cluster objects once the distances have been computed. We will briefly discuss two types of distance measures that can be used to cluster people with similar cognitive systems; no attempt will be made to discuss the numerous clustering algorithms that are available. (See Naylor & Wherry, 1965; Wherry & Naylor, 1966, for discussions of clustering individuals based on judgments.)

\textbf{Similarity between Judgments}

The correlation between the judgments made by two individuals over the same set of cases can be used as a measure of similarity between individuals. This measure has the advantage that no models of the cognitive system are needed, and,
therefore, errors in the analysis of each individual’s cognitive system will not affect the clustering. It has the disadvantage that the unreliability in the individual’s judgments will affect the clustering, and therefore it will be possible for two people who have similar cognitive systems to be placed in different clusters simply because both persons are inconsistent.

**Similarty between Models**

The correlation between two cognitive systems executed with perfect consistency (C from the lens model equation) can also be used in cluster analysis. This measure eliminates unreliability from the clustering but may produce poor clusters if the analysis of cognitive systems has not been carried out properly (if, for example, the wrong cues or an inappropriate model has been used).

In most applications the second method is preferred because it takes advantage of the judgment analysis. The first method should be used only when one is unable to perform an analysis of judgment or has reason to distrust the results of such an analysis.

We hope that some misconceptions concerning the use of the above quantitative method will be corrected as a result of the above discussion. For example:

1. **Misconception**: SJT is tied to the linear regression model. **Fact**: Linear regression is only the starting point for the analysis.

2. **Misconception**: The method of SJT involves observation of an individual’s judgment on one occasion by a single method. **Fact**: A multimethod approach is advocated.

3. **Misconception**: Social judgment theorists offer their models as psychological laws—that is, as isomorphic representations of the process underlying judgment. **Fact**: Models are sought as useful aids to individuals and groups who must exercise their judgment.

4. **Misconception**: The goal of social judgment theorists is to increase the accuracy of judgments. **Fact**: Increased accuracy is only one goal pursued in the effort to aid individuals and groups.

**APPLICATION OF THEORY AND QUANTITATIVE METHOD TO EMPIRICAL RESEARCH: GENERALIZATION OVER CASES**

In keeping with their premises and research aims, social judgment theorists insist upon seeking generality over conditions (rather than generality over persons) as a test of the utility of the theory. They have, therefore, extended their research to four cases major types of circumstances.

Before the results are discussed, the importance of increasing the generality of the data should be emphasized. For example, the test of the test in this study involves conditions (orthogonal to the orthogonal varying task content, variable task conditions of several different forms, and intercorrelations among them). Failure to incline results in the test being used in tasks rather than variables over tasks with different degrees of agreement and correlation. It is a test of the degree of agreement and correlation, rather than tests of the degree of agreement and correlation, which are of maximum interest. Most is self to a case ordinarly the case involving identical case which omits the circumstances which gave it first place. (See Hamon treatment of this point.)

More important, because the results of the research over conditions, in which human judgment studies have been isolated from others within the task conditions are judgment theorists for widely differing circumstances which give support to the theory.

**DISCUSSION OF UNIQUE CONDITIONS**

Social Judgment Theory judgment situations. The double-system case, the case. Space does not permit that SJT has made
research to four cases which, in their view, encompass the major types of circumstances in which human judgment is employed.

Before the results obtained in each of the four cases are discussed, the importance of testing over conditions needs to be emphasized. For example, conventional judgment theorists typically test their cognitive models under one set of task conditions (orthogonal arrangement of task dimensions) while varying task content, whereas social judgment theorists argue that the test for generality should be made over tasks with several different formal properties (for example, various intercorrelations among task dimensions) irrespective of content. Failure to include different formal task properties results in the test being one of reliability of results within tasks rather than validity of results over tasks. Testing over tasks with different substantive properties is, therefore, hardly a test of the generality of the model, inasmuch as the identical formal properties of the task can be expected to evoke from the subject the identical method of integrating the data. Since judgment tasks outside the laboratory obviously differ widely in their formal properties, any model which possesses only substantive generality is a model of highly restricted generality, and thus of little theoretical or practical interest. Most important, this procedure restricts itself to a case ordinarily not found outside the laboratory, the case involving independent task dimensions; it is a peculiar case which omits causal entanglement, and thus omits the circumstances which gave rise to the judgment problem in the first place. (See Hammond & Stewart, 1974, for a detailed treatment of this point.)

More important, because of their indifference toward generality over conditions, conventional judgment theorists seldom cross-validate over the variety of sharply different conditions in which human judgment takes place; virtually all their studies involve (1) a person who exercises his judgment in isolation from others with regard to (2) a situation in which the task conditions are unknown to him. In contrast, social judgment theorists insist on testing the utility of SJT across widely differing circumstances, as will be shown below.

**DISCUSSION OF UNIQUE CONTRIBUTIONS IN FOUR CASES**

Social Judgment Theory distinguishes among four types of judgment situations. These are the single-system case, the double-system case, the triple-system case, and the N-system case. Space does not permit discussion of the research carried out within each case; therefore, only the unique contribution that SJT has made to each case will be mentioned.
THE SINGLE-SYSTEM CASE

This is the case ordinarily studied by judgment theorists (see, for example, Anderson, 1971; Edwards, 1968; Kelley, 1973). In this case the judgment processes of the person making the judgment are the only phenomena of interest. No task information other than the value of the cues (or "stimuli") and possibly their interrelations is considered by the researcher.

Unique Contribution: Separating Knowledge from Cognitive Control

The separation of knowledge and cognitive control (see the above section on quantitative method) has led to a new view of the competence of human judgment and to a shift in theory. Initially the concept of cognitive control was made equivalent to consistency (Hammond & Summers, 1972). That is, the random error in the subject's judgment system provided a measure of his control over, and thus his consistency in applying, his judgment policy. It is now clear that these terms should be separated, conceptually and mathematically (see above), due to the results of several recent studies.

These studies began with an effort to train two undergraduates to exercise control over their judgment processes in what were presumed to be a variety of highly complex tasks—tasks which involved differential weights and various function forms. For example, a simple judgment policy is one which requires only that the subject assign equal weights to, say, three cues, use the information from all three cues in terms of a positive linear function, and employ an additive organizational principle. A more difficult task would require the subject to assign differential weights to the cues and to employ different function forms (for example, a positive linear function form for cue 1, a negative linear function form for cue 2, and a U-shaped function form for cue 3).

The results from an initial study were surprising. The two students were able to exercise effectively various judgment policies over a wide range of tasks which had been presumed to be beyond their capacity. Gillis, Gritz, and Stewart (1975) found the same results with normal controls, and also found that methadone addicts and chronic schizophrenics (under medication) performed nearly as well. Steinmann's study (1974) of college students confirmed the results Gillis and his colleagues obtained with normal subjects. Further work by Weichselbaun (1975) confirmed their results with normals as well as with methadone addicts. In short, studies carried out by different investigators in different laboratories over a variety of subject populations—under the proper condition over their judgment process relations than had been supposed.

To grasp the significance of member that although the human subject has an almost unlimited capacity, the limitations of human subject can execute a to organize information drawn in function form and in working memory. Whether human subject of the complexity involved another question.

THE DOUBLE-SYSTEM CASE

In this case (see Figure 1 about one task system; in contrast to the single system are unknown), and, as a result, the second task system which judgments are to be made by the double-system case must be added, as well as the circumstances of the system and the rate at which the system is important matter. In this case, a unique contribution.

Unique Contribution: Prov of Interactive Computer Game

The traditional S-R approach to the provision of the correct feedback by the teacher is much too slow. This is dependent upon receiving the appropriate discovery method. The other alternative type of feedback, the given feedback of a cognitively about the properties of the system, they could rapidly improve the outcome feedback (that is,
variety of subject populations have provided a clear result: Under the proper conditions, human beings can exercise control over their judgment processes with respect to far more complex relations than had been suspected.

To grasp the significance of these findings, one must re-
member that although the layman expects human judgment to have almost unlimited capacity, judgment researchers have stressed the limitations of human judgment again and again (for a recent example, see Tversky & Kahneman, 1974). The finding that hu-
mans can execute a judgment policy that requires them to organize information drawn from dimensions that vary widely in function form and in weights is, therefore, an important one. Whether human subjects in fact execute judgment policies of the complexity indicated above outside the laboratory is another question.

THE DOUBLE-SYSTEM CASE

In this case (see Figure 1), one person makes judgments about one task system; in addition, task outcomes are known (in contrast to the single-system case, in which task outcomes are unknown), and, as a result, task structure is known. More-
ever, the second task system might be a second person about which judgments are to be made. The immediate question raised by the double-system case is the accuracy of judgments, as well as the circumstances which enhance or impair it. In addition, the rate at which one learns to improve his judgment is an important matter. It is in this area that SJT has made a unique contribution.


The traditional S-R approach to these problems is based on the provision of the correct answer after each trial. How else can people learn other than by observing task outcomes? Unfortunately, social judgment theorists who studied what during the 1960s was called "multiple-cue probability learning" accepted all too readily the traditional notion that learning is dependent upon receiving outcome feedback. A wholly for-
tuitous discovery by Newton (1965), however, that subjects might well be able to improve their performance without outcome feedback led Todd and Hammond (1965) to investigate an alter-
native type of feedback. They showed that if subjects were given feedback of a cognitive nature (that is, information about the properties of task systems and their judgment sys-
tems), they could rapidly improve their performance without outcome feedback (that is, without being told the correct
answer after each trial). Moreover, they found that providing outcome feedback in addition to cognitive feedback did not improve accuracy. Indeed, Hammond, Summers, and Deane (1973) later showed that adding outcome feedback could result in the impairment of performance. These preliminary results, obtained from experimental situations involving only the crudest of equipment and materials, led to the search for an appropriate means for displaying (1) the properties of task systems, (2) the properties of cognitive systems of persons, and (3) the degree of match between them. Procedures involving interactive computer graphics techniques (mentioned above) were developed for this purpose and are now in use (see Hammond, 1971; Stewart & Carter, 1973; Hammond & Brehmer, 1973).

These procedures allow the subject not only to see the properties of his own judgment policy (the weights attached to cues, function forms employed, and the control with which he is executing his policy), but also to compare his policy with that of another person (or with the properties of the task to be dealt with if these are known; see Figure 3). Thus, interactive computer graphics techniques permit the human subject not only to see a representation of the "cognitive map" that Tolman (1948) spoke of, but to compare it with the causal texture of environmental (or task) systems Brunswik (1956) argued should be investigated in depth. Moreover, cognitive maps of several persons (or task systems) can be compared. Such cognitive material is, of course, appropriate to a cognitive theory intended to be free of stimulus-response concepts.

Furthermore, as Lindell (1974) has shown, cognitive feedback enhances learning in those difficult judgment tasks in which task variables are intercorrelated and differential weights are involved.

This contribution by SJT—the development of a cognitive aid—has important practical applications, for it is now clear that it is no longer necessary to try to learn how to improve one's judgment by means of outcome feedback (indeed, if the task is complex and involves uncertainty, it will never be learned by means of outcome feedback), nor is it necessary to try to learn what the properties of another person's judgment policy are by interrogation on one person's part and introspection on the other's. Persons exercising their judgment can discover, immediately and in pictorial form (by means of computer graphics), the properties of their own judgmental system, as well as the properties of another person's judgmental system, and change those properties, if they desire, with complete control. That capability carries considerable significance for judgment situations in which more than one policy maker is involved and in which interpersonal conflict and interpersonal learning become significant phenomena, a point to be developed below.

Social judgment theory requires variation in interpersonal conflict, interpersonal learning, and by judgment by anyone. Involved in a unique contribution is Interpersonal Conflict.

Interpersonal Conflict

Social judgment approaches to the study of cognitive differences in judgments, whereas potential gain as the always dominated the enough, neither possibility that the produce conflict, was set forth by Brehmer (1973).

The studies carried out by themselves are capable of showing that it is important in all cases that interpersonal conflict can readily be changes in task pro...
that providing feedback did not result in the results, obtained in the crudest of inappropriate systems, (2) and (3) the training interactive systems were developed (Stewart, 1971; Stewart and others, 1971).

To see the process attached to the task with which he was to work, his policy with respect to the task to be taken. Thus, interpersonal conflict arises from different judgments and interpersonal learning were two highly important topics untouched by judgment theorists and, indeed, hardly investigated by anyone. Investigation of these problem areas is therefore a unique contribution made by social judgment theorists.

Unique Contribution: Uncovering Cognitive Sources of Interpersonal Conflict

Social Judgment Theory differs sharply from all other approaches to the study of conflict because if focuses only on cognitive differences between persons who arrive at conflicting judgments, whereas all other approaches focus only on differential gain as the source of conflict; the latter approach has always dominated the field of conflict research. Strangely enough, neither psychologists nor others entertained the possibility that the properties of judgment processes may themselves produce conflict. The basis for the cognitive point of view was set forth by Hammond (1965) and elaborated by Hammond and Bremer (1973).

The studies carried out by Bremer and others (to be reported below) support the theory that cognitive differences in themselves are capable of producing conflict; they clearly show that it is unnecessary to appeal to motivational explanations in all cases of conflict. Indeed, it is clear that conflict can readily be increased, diminished, or eliminated by changes in task properties alone.

The Research Paradigm

The problem in extending SJT to engage this topic was, first, to create circumstances under which it would be possible to observe the interaction between persons whose judgments differ and, second, to discover whether the concepts of SJT in
general, and the parameters of the lens model equation in particular, would provide new and useful information regarding the interaction.

Experiments within the SJT research paradigm for the triple-system case simulate a situation in which two persons make inductive inferences from uncertain information (cues). They use the cues differently, however, to arrive at their judgments—that is, they have different judgment policies. Differences in judgment policy can be created in the laboratory by training the persons to use the information differently, but it is also possible to select persons whose differences stem from differences in preexperimental experience. The training procedure has the advantage of allowing the investigator to create precisely whatever differences in judgment policy are required for the experiment; the selection procedure, on the other hand, allows the investigator to study socially induced rather than laboratory-induced differences. The findings so far, however, indicate that the same results are obtained regardless of whether training or selection is used (Hammond & Brehmer, 1973; Hellenius, 1973; Rappoport, 1969).

The research focuses upon the changes in judgments that occur as the two persons interact with each other and with the task. Agreement and conflict are defined objectively in terms of the actual differences between the judgments made by the subjects for each problem rather than in terms of subjective factors (for example, in terms of whether the persons feel that they are in conflict or not). The experiments are conducted in two stages: a training stage, in which the subjects are trained to have different policies, and a conflict stage, in which the subjects are brought together in pairs to work on a set of problems. The problems in the conflict stage usually differ somewhat from the problems in the training stage, but the persons are not informed of this or of the fact that they have been differently trained. On each trial in the conflict stage, the subjects (1) study a set of cues, (2) make individual judgments from these cues which (3) they announce to each other, and if their judgments differ, (4) they discuss the case, until (5) they can reach a joint judgment, agreeable to both of them, after which (6) the correct answer for the problem is given. The relation between the individual judgments mentioned in (2) defines the amount of conflict and is thus the primary dependent variable.

Interpersonal Conflict Arising from Differences in Judgment

A first important question is whether it is possible to produce disagreement by means of the research paradigm described above, and if it is possible, whether persons resolve their

judgmental differences with the task. The studies carried out to date indicate that it is indeed possible that the disagreement can be resolved.

Analysis of Conflict

The above-mentioned conflict is not resolvable by an examination of a single judgment. This measure of conflict is defined as the systematic aspects of the two sources.

\[ r_a \]

where \( r_a \) is the correlation between the judgments of the two sources.

In this equation, the correlation is the extent to which the judgments of the two sources resemble each other. As can be seen from the equation, the correlation can be obtained only if the two sources are identical in their policies or if their policies are equivalent (\( r_a = 1.00 \)). Thus, the two sources in judgment policy for \( r_a = 1.00 \) in every case.

1In the following section, we discuss the possibility of two rival, non-exclusive hypotheses for the studies discussed, that would coincide with the data: therefore \( R \) is a valid procedure resulted in the conflict procedure model; only weights are necessary to explain the organizing tendency and control an
judgmental differences as they interact with each other and with the task. The results of roughly 30 studies (including studies carried out in 12 different countries) show, first, that it is indeed possible to produce disagreement and, second, that the disagreement is not resolved (Hammond & Brehmer, 1973).

Analysis of Conflict in Terms of the Lens Model Equation

The above-mentioned results lead to the question of why conflict is not resolved. The question can be answered through an examination of a measure of conflict based on the lens model equation. This measure expresses the effects of two sources of conflict: systematic as well as nonsystematic differences in judgment policy. Equation (4) disentangles the effects of these two sources. Recall that

\[ r_a = G \cdot R_1 \cdot R_2, \]

where \( r_a \) is the correlation between the judgments made by Subject 1 and those made by Subject 2 and the other terms are interpreted as in the quantitative discussion above.

In this equation, \( r_a \) is a measure of the amount of agreement between the judgments of Subject 1 and Subject 2, \( G \) indicates the extent to which the two judgment policies are similar with respect to their systematic aspects, and \( R_1 \) and \( R_2 \) indicate the consistency of each of the judgment policies and thus provide a measure of the nonsystematic differences in judgments.¹

As can be seen from the equation, perfect agreement (\( r_a = 1.00 \)) can be reached only if the subjects are identical in the systematic aspects of their judgment policies (\( G = 1.00 \)) and their policies are executed with perfect consistency (\( R_1 = R_2 = 1.00 \)). Thus, the two possible sources of disagreement, differences in judgment policy (\( G < 1.00 \)) and inconsistency (\( R_1 \) and for \( R_2 < 1.00 \)) in execution of policies, can be measured. This distinction shows that the mere observation that persons differ

¹In the following discussion, \( R \) is used as a measure of consistency for two reasons: (1) The term "consistency" was used exclusively in the original literature cited here. (2) In the studies discussed, the mean of a set of repeated judgments would coincide with the predictions based on the model, and therefore \( R \) is a valid measure of consistency. The training procedure resulted in subjects' using an additive policy, and the conflict procedure did not elicit a different type of model; only weights and function forms changed during conflict, with the organizing principle remaining unchanged. Consistency and control are thus identical.
in their judgments does not allow the inference that there are fundamental differences between judgment policies. The two persons may lack perfect consistency, and thus their differences may be caused by inconsistent execution. The question, then, is whether subjects fail to reduce their conflict because they are unable to reduce the systematic differences between their policies or because they are unable to execute their judgments with perfect consistency.

**Results**

The results of a series of analyses of sources of conflict show that the relative importance of the two sources of policy conflict changes as the subjects interact with each other and the task. At the beginning of the interaction, most of the conflict is caused by the systematic differences in policy, but these differences are rapidly reduced. At the same time, however, the consistency of the subjects' policies decreases so that at the end of a 20-trial conflict period, lack of consistency rather than systematic differences in policy is the main obstacle to agreement.

**Replications**

Some typical results are shown in Figure 4. These results have been replicated over subject conditions, such as nationality (Brehmer, Azuma, Hammond, Kostron, and Varonos, 1970) and sex (Hammond & Brehmer, 1973), and task variables, both with respect to content (Hammond & Brehmer, 1973) and with respect to formal characteristics, such as task predictability (Brehmer, 1973c, 1974c), the distribution of the validities of cues (Brehmer, 1974c), and the forms of the functions relating cues to criterion (Brehmer & Hammond, 1973; Brehmer & Kostron, 1973). The results obtained when the subjects have been selected because of their preexperimental differences are similar to those obtained when the subjects have been trained to have different policies (Rappoport & Summers, 1973).

**Changes in Cue Dependencies: Negative Consequences of Good Intentions**

Subjects decrease their dependency on the cues used initially at a faster rate than they increase their dependency on the cues used by the other person (see, for example, Brehmer, 1972). This necessarily leads to a drop in consistency since $P_1$, which defines consistency, is related to the sum of the individual cue-judgment correlations which define the subjects' dependency on the individual cues. And a decrease in $R$ means...
that there are significant differences. The two countries are different in their differences in judgment policy. The question, therefore, is one of conflict because the subjects have different policies between them.

in policy, the same time, the percentage decreases and the lack of common policy is the

These results (such as nation-specific phenomena, 1970) yield almost all of the results, both elementary and with predictability and valuations, and with the predictions relating to Kostron, have been shown to be common to similar conditions as in the Brehmer & Kostron, 1972, study. The results of the study are shown in the figure.

Fig. 4. The relative contributions (percent) of policy differences (sum of differences in beta weights divided by 2) and inconsistency \(1 - \left(\frac{R_{1}^2 + R_{2}^2}{2}\right)\) to disagreement as a function of blocks of trials for the five-nation study.

A decrease in \(R_2\) and thus a decrease in agreement, despite good intentions.

A study by Brehmer (1972) in which both subjects were trained to have identical judgment policies illustrates the role of change and inconsistency. As the subjects tried to increase their judgmental accuracy in the conflict stage, they began to change; inconsistency developed (their \(R\)'s decreased), and the subjects began to disagree (\(r_2\) decreased), yet their judgment policies remained virtually identical throughout the experiment (as shown by high \(G\) values). Thus, inconsistency will not only prevent subjects from reaching agreement but may also introduce disagreement where no prior disagreement existed. As this study indicates, however, disagreement may be false, since the judgment policies remained virtually identical.

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Behavioral Validation of the Meaning of Inconsistency

The first part of the hypothesis, that inconsistency leads to a lack of understanding, has gained support from two studies (Brehmer, 1974d; 1975) which show that subjects ask each other more questions when their policies are more inconsistent, thus indicating that inconsistency does indeed lead to lack of understanding and that inconsistency is not a mathematical fiction. (Whether inconsistency leads to distrust has still to be investigated.) A different type of behavioral validation has been carried out by Gillis (1975). We found that the phenothiazines commonly used as therapeutic agents in psychiatric hospitals have a deleterious effect on consistency. In short, inconsistency has been systematically related to behavioral observations.

Conflict Reduction or Task Adaptation?

The results of a series of studies using these conditions support the latter alternative: Only the subject with the incorrect policy shows any appreciable change in policy (Brehmer & Kostron, 1973; Brehmer, 1975; see also Brehmer & Garpebring, 1974).

These results show the important contribution of task characteristics to conflict arising from different judgments and support the value of analyzing conflict in terms of three systems rather than restricting the analysis to person characteristics, as is typical of an organism-centered psychology.

Effects of the Characteristics of the Task on Conflict

We turn now to an examination of the effects of formal characteristics of the task on conflict.

Task Consistency

If judgment policies in a conflict situation are affected by the characteristics of the task in the same way that they are in policy formation, these results lead to the prediction that subjects will develop less consistent policies in conflict tasks of high uncertainty, and, therefore, there will be less agreement under these conditions than when the task is highly predictable. This hypothesis has been confirmed repeatedly (Brehmer, 1973c, 1974b, 1974d, 1975).
Ecological Validities of Cues

When the tasks contain only linear relations, the distribution of the validities of the cues affects the consistency ($R$) but not the similarity ($G$) of policies. In this case, the policies tend to be more consistent when the subjects have to use only one cue than when they have to use multiple cues (Brehmer, 1975). However, both policy similarity and consistency are affected when the tasks contain both linear and nonlinear cues (Brehmer & Kostron, 1973). In the latter case, both policy similarity and consistency tend to be higher when the subjects have to use only one cue. These results are presumably due to the difficulties inherent in the use of nonlinear function forms (see Brehmer, 1971a, 1971b, 1973b, 1973c).

Task Function Forms

Nonlinear function forms lead to lower consistency, presumably because nonlinear functions are harder to execute (see Brehmer, 1971b). The degree of policy similarity ($G$) is not affected by the function forms, however (Brehmer & Hammond, 1973; Brehmer & Kostron, 1973).

Cue Intercorrelations

Task characteristics also introduce certain constraints on the relation among agreement, judgmental accuracy, and policy similarity. For example, if the cues are positively intercorrelated, the subjects will reach a high level of agreement despite differences in policy. In addition, the intercorrelation between the cues will allow a subject who uses a cue that is in itself of no validity to reach a high level of judgmental accuracy, since the correlation between the cues will ensure that judgments become correlated with one another. When the cues are orthogonal, on the other hand, differences in policy will be directly reflected in disagreement, and dependency on nonvalid cues will lead to a lack of judgmental accuracy. In short, positive cue intercorrelations will lead to agreement in fact, despite disagreement in principle; they will also lead to judgmental accuracy, despite a faulty policy. This means that when the cues are intercorrelated, there will be less need for the subjects to change their policies, and this, in turn, leads to the hypothesis that the subjects will reach a lower degree of policy similarity when the cues are intercorrelated than when they are orthogonal. This hypothesis was supported in two experiments (Brehmer, 1974b).
These results, then, show that both the level of agreement and the relative contributions from the two sources of agreement vary in a predictable way with the nature of the task.

Summary

First, our results show that conflict arising from different judgments is not resolved even under the benign conditions prevailing in these experiments. Conflict can indeed be caused by purely cognitive factors; the commonsense notion that disagreement always involves motivational differences is incorrect.

Second, our results show that conflict does not persist because the subjects are determined to maintain the systematic differences between their policies; on the contrary, in these studies systematic differences between policies are usually rapidly reduced. But conflict persists, and it persists because of a lack of consistency. The lack of consistency, in turn, stems from the manner in which the subjects change their policies.

Third, the results illustrate the importance of task variables in conflict. The task is important, first, because it is the general focus of cognitive activity in the situation, second, because of its effects on the structure of the judgment policies of the participants and thus on agreement, and, third, because of the constraints it places on agreement, judgmental accuracy, and policy differences.

Interpersonal Learning (IPL)

Space permits only a brief summary of the rationale and results of the studies of interpersonal learning carried out by social judgment theorists. Research in this area is divided into two categories: IPL from the other and IPL about the other. Each is discussed in turn.

Interpersonal Learning from the Other

The research paradigm used in the triple-system case to study interpersonal conflict lends itself very readily to the study of IPL from the other because the investigator can specify the properties of the cognitive systems of both learners as well as the task to be learned.

Task Variables and Interpersonal Learning

A series of studies has investigated the effects of task variables, such as task predictability (Brehmer, 1973a, 1974a, 1974b), function form (Brehmer, 1973a, 1973b; Earle, 1973; Hammond, 1972), the disjunctions (Brehmer, 1974a); the effects of these variables on the individual learning nonlinear relations in learning than in individual learning is nevertheless relations than for task variables.

The Effects of the Char and the Learner and the Other

A stable result in these concerns con- trained to use a nonlinear task requires the subject to give up his belief that the linearly trained subject also learns to use the early trained subject (Hammond, 1972; Brehmer, 1975), and Zachariadis (1977) has studied these results in studies on interpersonal learning.

Interpersonal Learning

The research paradigm facilitates the study of this study (Humphrey & Hammond). This study was conducted, the different judgment policy described above, in the case of a two-cue judgment task intercorrelated. Each judgment affects the judgments of the other in the case in which joint policies to the job are highly similar. Unrestricted dis...
Hammond, 1972), the distribution of validities of the cues (Brehmer, 1973a, 1973b, 1974a, 1974b), and cue intercorrelations (Brehmer, 1974a). The results of these studies show that the effects of these variables are similar to those obtained in the individual learning studies, except that the learning of nonlinear relations in the task is more rapid in interpersonal learning than in individual learning. Thus, the results show (1) that subjects tend to have less optimal judgment policies when the task predictability is low than when it is high and (2) that although nonlinear functions are learned more rapidly in interpersonal learning than in individual learning, performance is nevertheless less optimal for tasks with nonlinear relations than for tasks with linear relations.

The Effects of the Characteristics of the Cognitive Systems of the Learner and the Other

A stable result in interpersonal learning studies (as well as those concerning conflict) is this: If one subject is trained to use a nonlinear relation and the other subject is trained to use a linear one, and if the interpersonal training task requires the subjects to use both the nonlinear cue and the linear cue to the same extent, the nonlinearly trained subject gives up his dependency on his trained cue faster than the linearly trained subject. The nonlinearly trained subject also learns to use the cue of the other faster than the linearly trained subject (Brehmer, 1969, 1971a, 1973a, 1973b; Hammond, 1972; Brehmer & Hammond, 1973). Gillis (1975), Gritz (1975), and Zachariadis and Varonis (1975) have replicated these results in studies of the differential effects of psychoactive drugs on interpersonal learning.

Interpersonal Learning about the Other

The research paradigm used in the triple-system case also facilitates the study of this type of IPL; we describe one study (Humphrey & Hammond, 1974) which illustrates its use. This study was conducted by training two persons to have widely different judgment policies, as in the conflict studies described above. In the first case, pairs made judgments about a two-cue judgment task in which the two cues were highly intercorrelated. Each member of a pair was then asked to predict the judgments the other would make in 10 additional trials. In the case in which subjects bring widely differing judgment policies to the joint task and the cues are highly intercorrelated in the joint task, subjects assume their judgment policies are highly similar because their judgments are similar. Unrestricted discussion does not lead them to detect the
fact that their judgment policies are very different; they do not realize that their agreement is false, that they are agreeing in fact while disagreeing in principle. In short, they do not learn accurately about each other because the characteristics of the task impede such learning. As soon as the task variables are disentangled (that is, are uncorrelated) by the experimenter, the subjects rapidly learn that they have different judgment policies; assumed similarity decreases, actual similarity remains the same, but predictive accuracy increases. Counterbalancing of conditions shows that the effect is produced entirely by task characteristics—that is, by causal texture.

In sum, SJT has been applied effectively and productively to the study of interpersonal conflict produced by cognitive differences. It has also been successfully applied to two types of interpersonal learning, topics which have not previously been studied in a systematic way. Uncovering the cognitive sources of conflict and the cognitive barriers to interpersonal learning carries large implications for policy formation.

THE N-SYSTEM CASE

This case includes the situation in which a number of persons are studied, regardless of whether the properties of the task system are known. If a number of persons exercise their judgment, policy factions can be detected by means of cluster analysis. As indicated in the quantitative section, this procedure will not only provide information about which persons are arriving at similar judgments but also indicate the characteristics of the disparate policies. Thus, the cognitive bases of conflict within the group are indicated.

Unique Contribution: Application of Social Judgment Theory to Social Policy Formation

The unique contribution of SJT has been to bring the theory, quantitative procedures, results of research, and technological innovations (externalization of judgment policies by means of interactive computer graphics) to bear on social policy formation outside the laboratory.

Several applications of SJT to social policy show that SJT is indeed life-relevant, that the methodology and the cognitive aids produced by it are appropriate to a wide variety of judgmental problems and demonstrate that although judgment theory is not law seeking per se, the empirical regularities observed in the laboratory are also observed outside the laboratory. Such empirical regularities include the following general conclusions: (1) Completely their judgments inconsistent in applying number of cues are unperson's policy simplifying to his explanation above can require (6) linear, additive, qualitative to describe judgments.

Examples of the approach in planning (Stewart about community goals; physicians'[judgments]: Stewart, West; Hammoness of SJT for technical illustration its application and Rappaport (1973) nuclear safeguards; and model of the complex Balke, Hammond, and management negotiation (1975) deal with policy).

SUMMARY

The theory, method above are unconventional books. But there are part of conventional search approach. The 1974) to the Division of Psychological Association warned his colleagues be elaborated without science because the statement [italics ours]" statement of agreement judgment theorists who for at least a decade advocated that research colleagues to "[relatively logically valid] (p. 794).

This striking departure included no acknowledgment fundamental, all-inclusi
conclusions: (1) People do not describe accurately and completely their judgmental policies, (2) people are often inconsistent in applying their judgmental policies, (3) only a small number of cues are used, (4) it is difficult to learn another person's policy simply by observing his judgments or by listening to his explanations of them, (5) the cognitive aids described above can reduce conflict and increase learning, and (6) linear, additive organizational principles are often adequate to describe judgment processes.

Examples of the applications include: citizen participation in planning (Stewart & Gelber, 1972); determining policies about community goals (Steinmann & Stewart, 1973); and modeling physicians' judgments (Stewart, Joyce, & Lindell, 1975). Stewart, West, Hammond, and Kreith (1975) describe the usefulness of SJT for technology assessment; Flack and Summers (1971) illustrate its application to water resource planning; Brady and Rappoport (1973) detail its relevance to policy about nuclear safeguards; and Smith (1972) provides a hierarchical model of the complex judgments of an investment analyst. Also, Balke, Hammond, and Meyer (1973) show its application to labor-management negotiations; Steinmann, Smith, Jurdem, and Hammond (1975) deal with public-land-acquisition policy; and Adelman, Stewart, and Hammond (1975) apply SJT to corporate policy formation.

SUMMARY

The theory, methodology, and research findings described above are unconventional; they are not yet described in textbooks. But there appears to be a growing recognition on the part of conventional psychology that it must change its research approach. The recent presidential address (Jenkins, 1974) to the Division of Experimental Psychology of the American Psychological Association provides an example; Jenkins warned his colleagues that "a whole theory of an experiment can be elaborated without contributing in an important way to the science because the situation is artificial and nonrepresentative" (italics ours) (p. 794). In addition to this surprising statement of agreement with Brunswik (1943) and social judgment theorists who have been making precisely that point for at least a decade (Hammond, 1955, 1965, 1966), Jenkins advocated that research should be life-relevant; he urged his colleagues to "[relate their] laboratory problems to the ecologically valid [Brunswik's term] problems of everyday life" (p. 794).

This striking departure from conventional methodology included no acknowledgment that Brunswik had called for a "fundamental, all-inclusive shift in our methodological ideology"
as early as 1943 (p. 261; see also Hammond, 1966, p. 23; Hammond & Stewart, 1974) and that until 1955 he continued to carry out empirical research and to write articles and books in which he seriously and responsibly considered the many implications of the change Jenkins advocated (something Jenkins failed to do). Perhaps social judgment theorists should be heartened and their convictions strengthened by what appears to be an independent discovery of their methodological position. But it remains to be seen whether conventional psychologists will relinquish "artificial and nonrepresentative" research designs or whether the need for representative design will have to be independently rediscovered periodically.

One might ask what social judgment theorists (who do not have to be convinced of the necessity for an "all-inclusive shift in methodological ideology" and who try to cope with the hard problems associated with that shift) intend to do in the second decade of their research. The foremost objective is to extend the limits of human judgment. We are particularly concerned with extending the limits of human judgment in the complex circumstances in which social policy is formulated. The reason for that is straightforward: Social, political, economic, and physical disasters of large scale appear to be imminent, and all of these problems require the exercise of human judgment. Estimates of the time remaining for human judgment to form effective social policies to cope with these problems range from a decade to a quarter-or perhaps a half-century. Social judgment theorists firmly believe that all students of human judgment should engage in research that will help provide better social policies and thereby increase our chances for a decent life on earth.

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HUMAN JUDGMENT and DECISION PROCESSES

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