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The Representativeness Heuristic and the Study of Judgment Under Uncertainty.

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Kahneman and Tversky have claimed that people make judgments of likelihood by an assessment of the similarity of a sample to a population — the representativeness heuristic. This paper critically evaluates the heuristic and the evidence for it. It is argued that the heuristic is not precisely formulated, and that it can be replaced by the proposition that people possess a number of intuitive statistical concepts which they apply to judgmental problems when judged appropriate. Kahneman and Tversky argue that the representativeness heuristic is responsible for the shortcomings of lay judgment, by normative statistical standards. In this paper it is argued that these shortcomings occur because people aspire to a different set of standards, attempting to meet and satisfy current practical concerns and to deal with the relatively concrete, specific and unstructured information prevalent in social reality. Under many circustances normative statistical procedures and standards are suboptimal for lay judgmental problems.

Kahneman and Tversky (1972, 1973) have proposed that lay judgments of probability are based on an assessment of the similarity of the uncertain event or sample to the population from which it is drawn. Judgments made by this criterion can be expected to deviate from judgments generated by normative statistical theory in predictable ways, and Kahneman and Tversky report a number of studies in which evidence for such deviations appears to have been obtained. Although statistical phenomena are commonly encountered in everyday life, people seem to be largely ignorant of statistical laws. The representativeness heuristic, as the similarity criterion is called, and the various claims associated with it, have been analysed and investigated by several authors (see Pollard and Evans 1983 for a useful review) and have been found to have certain shortcomings. This paper extends the critique of representativeness by arguing that it is not sufficiently precisely formulated, and can be replaced by the proposition that people possess a number of intuitive statistical concepts which they apply to judgmental problems when the features of the problem render them salient. In this paper an alternative approach to judgment under uncertainty is proposed that emphasises practical utility and not statistical optimality, and places limitations on the value for the layperson of adequate sampling.

Definition of the Representativeness Heuristic.

Kahneman and Tversky (1972) define representativeness as follows:

> "A person who follows this heuristic evaluates the probability of an uncertain event, or a sample, by the degree to which it is: (i) similar in essential properties to its parent population; and (ii) reflects the salient features of the process by which it is generated."
>
> (p. 430)

The realm of applicability of the heuristic is therefore judgments of probability of an uncertain event or a sample. Many of the studies carried out by Kahneman and Tversky (1972, 1973) (e.g. the Tom W. study from Kahneman and Tversky 1973, in which the judgment is from which of n populations was a given sample was drawn) involve judgments that are presumed to follow from this evaluation of probability, rather than merely being it.

Tversky and Kahneman (1982) further articulate this realm of applicability by distinguishing

four types of cases in which the heuristic is or can be invoked:

a) a class and a (value of a) variable in that class;
b) a class and an instance of that class;
c) a class and a subset (sample) of that class;
d) a (causal) system and a (possible) consequence.

Representativeness is then said to be a directional relation possessed by:

1. A value in regard to a distribution;
2. An instance in regard to a category;
3. A sample in regard to a population;
4. An effect in regard to a cause.

Far from clarifying the concept of representativeness this appears to be a concession that representativeness is, in fact, more than one thing. Tversky and Kahneman (1982, p.87) are effectively proposing three different types or determinants of representativeness: perceived relative frequency (case 1), similarity (cases 2 and 3) and causal beliefs (case 4). Moreover, the first of these appears incompatible with the purposes for which the heuristic is supposed to be employed:

> "In case (1), representativeness is dominated by perceived relative frequency or statistical association."
>
> (Tversky and Kahneman 1982, p.87)

But:

> "These assessments of representativeness should not be based on impressions of probability or frequency, which are to be explained by representativeness."
>
> (Tversky and Kahneman 1982, p.88)

In the former case, representativeness follows from perceived frequency; in the latter case, perceived frequency follows from representativeness. This does little to clarify the concept.

The definition of representativeness rests upon three key terms:
"similar", "essential" and "salient". None of these is defined by Kahneman and Tversky, and the heuristic cannot be used to generate predictions until acceptable precise definitions of these terms are provided. Such predictions are in fact generated by Kahneman and Tversky in an *ad hoc* manner, inasmuch as the similarity, salience and relative salience of different factors are simply assumed. As the following sections will show, the meaning of these terms depends upon not only other statistical concepts possessed by judges, but also the constraints, concerns and purposes that dominate and determine judgmental processes in social reality.

Lay Statistical Concepts.

Kahneman and Tversky argue that adherence to the representativeness heuristic is the principal, if not the sole, reason for the observed shortcomings of lay judgment by normative statistical standards. In this section that argument is criticised on two grounds: first, the predictions derivable from the heuristic are often either not clear or not what Kahneman and Tversky claim them to be, so that the heuristic does not successfully explain observed judgmental tendencies; second, people possess and use statistical concepts that are more complex than the heuristic, if not normatively more accurate.

Kahneman and Tversky (1972) claim that adherence to the representativeness heuristic is responsible for the frequently observed failures of subjects to take sample size into account when making judgments under uncertainty. The relationship between the heuristic and sample size, however, is not straightforward:

1. The evidence is also consistent with the opposite possibility: that subjects use the representativeness heuristic because they fail to appreciate the relevance of sample size, or because they have other reasons for not taking sample size into account.

2. The representativeness heuristic does not always lead to the prediction that people will ignore sample size information. In the case of estimates of sampling distributions, for example, Kahneman and Tversky (1972) argue:

> "When the sample is described in terms of a single statistic, e.g. proportion or mean, the degree to which it represents the population is determined by the similarity of that statistic to the corresponding parameter of the population. Since the size of the sample does not reflect any property of the parent population, it does not affect representativeness. Thus, the event of finding more than 600 boys in a sample of 1,000 babies, for example, is as unrepresentative as the event of finding more than 60 boys in a sample of 100 babies. The two events, therefore, would be judged equally probable, although the latter, in fact, is vastly more likely."
>
> (Kahneman & Tversky, 1972, p.436)

Subjects behaved as predicted, but the prediction is not in fact correctly derived from the

representativeness heuristic. Everything depends on whether subjects respond to absolute numbers or to proportions. If the latter, then Kahneman and Tversky are correct. If the former then the representativeness heuristic leads to a quite different prediction. Suppose one has chance expectations of 50 and 500 events of a certain sort respectively: now if subjects respond to absolute numbers then by the representativeness heuristic an observation of 60 in the former case will be judged more likely than one of 600 in the latter because 60 is more similar to 50 than 600 is to 500. In other words, if subjects respond to absolute numbers then the representativeness heuristic leads to the prediction that they *will* take sample size information into account. The fact that they do not means either that they use proportions or that they do not use the representativeness heuristic. Even in the former case, however, which is more likely (Bar-Hillel, 1982), the results obtained follow from normative statistical theory as well as from the representativeness heuristic, given the initial mistake of using propotions rather than absolute numbers. This implies not only that the study does not provide evidence for the use of the representativeness heuristic, but also that the authors have not correctly derived their prediction from the heuristic.

3. Sometimes the hypothesis that people use the representativeness heuristic leads to the prediction that they *will* take sample size into account. Suppose a random sample of n individuals is found to contain three who have occupation A and nine who have occupation B: are the three more likely to be lawyers or librarians? In this case use of the representativeness heuristic leads to the judgment that the three are more likely to be librarians, because the number of individuals sampled who have occupation A, relative to the number sampled who have occupation B, resembles the ratio of librarians to lawyers believed by people to exist in the population (Kahneman and Tversky 1973). In this case it is the representativeness heuristic itself that decrees that sample size information will be used.

The frequently-observed failure of subjects to take sample size information into account in judgments of probability is, therefore, not due solely (if at all) to the representativeness heuristic. Moreover, Evans and Dusoir (1977) and Bar-Hillel (1979, 1982) have shown that subjects do take sample size into account in the maternity hospital problem (Kahneman and Tversky 1972) if the linguistic complexity of the problem is simplified or the numbers altered: Evans (1983) argues that apparent failures to do so are problem representation or mental set effects, rather than preference for a judgmental heuristic.

This line of argument is consistent with the findings of Bar-Hillel (1979, 1980, 1982) that subjects do appreciate the greater value and reliability of larger samples over smaller ones. The lay concept of the relationship between sample size and reliability appears to differ from sampling theory, however, in that people regard samples of equal proportions of their respective parent populations as equally reliable, regardless of their absolute size.

There is now a growing body of research showing that people do possess various statistical concepts or intuitions, and that whether or not they apply these concepts to particular problems depends upon their perceived relevance. Tversky and Kahneman (1980) showed that base-rate information was utilized when it was made causally relevant. Kruglanski, Friedland and Farkash (1984) show that subjects make appropriate use of information about test reliability and of redundancy in information, and reason in accordance with the concept of regression, where information relating to each of these is made directly relevant. Moreover, in one of their experiments the concept of redundancy was shown to exert a greater influence on statistical judgment than that of representativeness. Kahneman and Tversky (1972) also showed that lay conceptions of the distributions of events across variables, like their concepts of the value of sample size, appear to be based on proportions rather than on actual numbers, although Olson (1976) has argued that the basis is in fact a concept of the *shape* of a distribution, rather than one of proportionality.

Although some of these intuitions deviate from normative statistical theory, they go significantly beyond the representativeness heuristic. Whether people possess these concepts, or reason appropriately on the spot when presented with a suitable and simple problem, is hard to judge: but the question is becoming not *whether* people can exhibit certain statistical intuitions or not but *when* they do. Arguably the representativeness heuristic is no more than another of these intuitions, appearing dominant only because it has been studied more than the rest.

Moreover, use of these other intuitions explains at least some of the findings obtained by Kahneman and Tversky as well as, or better than, the representativeness heuristic. In the maternity hospital problem (Kahneman and Tversky 1972), for example, the application of a concept of sampling distributions based on proportionality leads to the prediction that subjects will choose the answer "about the same", which was in fact the most popular answer in the study, without invoking representativeness at all. No prediction can be derived from the representativeness heuristic for that study unless we know whether similarity is defined in terms of proportions or real numbers; and if, as the evidence suggests, the former is the case, then the heuristic is not needed.

"Essential" and "salient" features, then, are those that elicit some lay statistical concept or intuition. This is not to argue that similarity judgments play no role in judgments of probability, but the role of similarity is more limited than Kahneman and Tversky allow, and similarity takes its definition from the statistical concepts that people possess. Lay statistical concepts and intuitions yield a set of expectations for any given problem, and the probability of an uncertain event or a sample is therefore assessed by considering the degree to which it violates the expectations that are applied. Precise predictions based on this principle require in addition specification of the particular statistical concepts possessed by laypeople, and of those that will be applied to a given judgment. The latter includes taking into account transient influences upon availability, such as mental set (Evans, 1983) and current practical concerns (White, in press). This principle constitutes a defensible replacement for the representativeness heuristic.

The Role of Practicality in Judgment under Uncertainty.

The arguments in the preceding section, as well as those of Kahneman and Tversky, have assumed that statistical concepts are all that people recruit in the attempt to solve the tasks set by Kahneman and Tversky, and that the right answer is what people are attempting to achieve. Little consideration has been given to the sorts of approaches to judgments under uncertainty that are appropriate or common in everday life, the sorts of judgments under uncertainty that people are and are not familiar with and used to making, the reasons why they do so, and the real world constraints and demands plced upon them. Concentration on areas of proneness to error has resulted in neglect of areas and respects in which judgment is, if not accurate by statistical standards, then adequate by standards more relevant to the layperson. Statistical theory is only optimal for information that meets certain specific standards of sampling rigour, and only for certain types and goals of judgment. In this section it will be argued that those standards, types and goals are unrepresentative of those prevalent in social reality, and that it is for that reason that lay judgment is inaccurate by normative statistical criteria.

Two propositions are fundamental to the following analysis: a) that the type of information with which people have to deal most frequently, and are for that reason best equipped to deal with, is relatively concrete, specific, everyday and unstructured; and b) that the object of judgment is not to produce an outcome that is "right" in an objective or normative sense but an outcome that satisfies whatever practical concerns are operative at the time. Further discussion of these propositions and evidence for their validity are presented elsewhere (White, in press).

The characteristics of information available in social reality and the importance of practicality are responsible for statistically suboptimal tendencies in judgment in several ways:

1. *Sampling feasibility.* Normative statistical theory recommends the use of large samples. Statistically adequate sampling is not feasible for the layperson for several reasons. First, the limitations on human processing capacity are such that little available information can be subjected to more than cursory processing, and much will be ignored or lost. Little of what is available, and correspondingly little of what is processed in depth and stored, is relevant to any particular judgment. Second, individuals are rarely if ever able to engage in any form of deliberate sampling, and must make do with whatever information they can obtain, however little that may be. Third, even if the opportuntiy for sampling exists, the practical necessity to make a judgment with speed often outweighs the value of taking the time to obtain a more reliable sample of information. Practicality therefore dictates that individuals must be accustomed to generating judgments with small amounts of information,

and several studies have obtained support for this proposition (Nisbett & Borgida, 1975; Nisbett, Borgida, Crandall & Reed, 1976; Borgida & Nisbett, 1977; Read, 1983).

2. *Judgmental specificity.* Normative statistical theory does not permit precise judgments to be based on small amounts of information: the smaller the amount of information processed, the greater the confidence interval associated with judgments derived from it. Everyday judgments cannot take confidence intervals into account, however: since most judgments have practical consequences, they must in effect be precise judgments. A selection panel, for example, cannot realistically take into account the confidence interval attached to a prediction about job performance based on level of performance exhibited in a test or interview, because they must discriminate between candidates. Differences between candidates that are too small to be statistically reliable are often the only available guide for decisions. For this reason, judges have no choice but to treat the available information as if it were of the best quality — in effect to respond to the observed mean and ignore the confidence interval. The fact that, as Bar-Hillel (1982) discovered, the mean is given more weight in judgments of probability than almost any other factor is consistent with this notion.

3. *Sample bias.* The value of adequate sampling procedures is tempered by the possibility of bias. When sampling is of instances from memory, a variety of possible biases affect recall processes (Nisbett & Ross 1980, Hastie 1981), as well as processes involved in the initial storage of information. Sampling from the real world is also subject to bias: for example the locally available environment and people may not be representative of the population about which judgment is to be made (proposed by Ross, Greene & House, 1977, as a possible explanation for the false consensus bias observed by them), and the mass media also present an unrepresentative view of events in the world (Slovic, Fischhoff & Lichtenstein, 1976). The importance of this in the present context lies in the fact that if available information is inevitably, or even possibly, biased then there is nothing to be gained from obtaining larger samples of it: the point of proper sampling is to gain more representative information; if this cannot be achieved then obtaining a large sample is a waste of time and effort, even for a statistician. Thus if people sometimes overlook the statistical importance of sample size it is because, under the circumstances of real life, sample size actually is of little importance.

4. *Concrete versus abstract information.* Most available information in the real world is concrete, specific and everyday, which contrasts with the abstract, often written, information presented in laboratory studies of judgment. For this reason most lay judgmental processes must be adapted to concrete and specific information. It is for this reason that concrete information is more influential on judgment than abstract or statistical information (Nisbett et al., 1976; Borgida & Nisbett, 1977), and samples of one concrete, specific case are more influential than an actually statistically more reliable summary of a large sample. In the studies of Kahneman and Tversky, one should therefore expect that subjects will utilize the most nearly concrete information available to them, and this is indeed the case. In the Tom W. study and in the lawyer/engineer study (both in Kahneman & Tversky, 1973) information about persons is doubly concrete by being both specific and about one person, and explicit in the material presented to the subject, whereas information about base-rates is both abstract and, in the former case, not included in the material. It is, therefore, not surprising that Kahneman and Tversky found no utilization of base-rate information. Subjects' judgments are statistically imperfect, but well adapted to the nature of social reality which, for them, is what matters.

Subjects use not only concrete information but also concrete reasoning processes: this tendency has been observed in other areas (Byrne, 1983) and may occur in statistical judgments also. When asked to estimate how many people one needs to have in a room before the probability of any two sharing the same birthday exceeds 0.5 (Kahneman & Tversky, 1972), a friend judged the answer to be about 200 (it is in fact 23). When asked how she had arrived at this answer, she replied that she had been thinking back over her experience as a speech therapist with clients' birthdays. A concrete reasoning approach to the Tom W. problem (Kahneman & Tversky, 1973) would involve working out how Tom W. finds a career for himself, being the person he is, rather than judging which of a number of populations a sample of one was drawn from. There is no place for base-rate information in the concrete conceptualisation: people are thinking not about sampl-

ing but about individual development. Their approach is practical, reflecting ways of dealing with the sort of decision Tom faced, but again what is most practical is not statistically optimal.

5. *Population information.* Most information available in social reality is not only concrete but also particular — instances which perhaps can be collected into small samples. Information about populations is rare; valid and reliable population information even more rare. People are therefore familiar with inferring from the particular to the general, from the sample to the population, but not with inferring from the population to the sample or instance. In support of this line of reasoning, Nisbett and Borgida (1975) found that people would readily infer from a sample of two individuals to a group average, but not from a given group average to the behaviour of individuals. This poses two problems. First, the representativeness heuristic can only be used when both sample and population information are available: this is such a rare occurrence that use of the heuristic in real life must be at least uncommon. Second, correct solutions to many of the problems set by Kahneman and Tversky require inferences to be made from population information. The Tom W. study and the maternity hospital study are cases in point, as are studies of lay ignorance of regression effects (Kahneman & Tversky, 1973). Failures to use relevant population information in these studies only show that lay judgment is adapted to the conditions of information availability in social reality.

6. *Mundane transformations.* Information that is in form or content unrepresentative of everyday reality as understood by the judge is likely to be transformed into more familiar form or content, or into a form more suitable for treatment with existing processes (Revlin & Leirer, 1978; Harris & Monaco, 1978; Evans, 1982). In experiments, unusual or unfamiliar tasks, instructions or information are candidates for such transformations, and many of the tasks set by Kahneman and Tversky are sufficiently unusual and unfamiliar to suffer such transformation at the hands of their subjects. In their studies of the conjunction effect, for example (Tversky & Kahneman, 1982; Kahneman & Tversky, 1982; Solvic et al., 1976) subjects may be not assessing the conjunctive probability of two events (e.g. that Borg will lose the first set *and* win the match), but carrying out the probably more familiar, and more nearly concrete, task of assessing the probability of one subsequent event given one prior event (e.g. that Borg will win the match *given* that he has lost the first set).

Kahneman and Tversky (1982) themselves point out that too little is known about what subjects actually do in experimental tasks, and that it is not safe to assume that they do what the task appears to compel them to. The conjunctive probability studies are a case in point: another case is one in which the experimenters overlook the applicability to a task of concepts or judgmental tendencies that they have themselves demonstrated in different contexts. For example, Kahneman and Tversky (1972) argue that their birth order study shows that some sequences of events, in this case exact orders of birth of boys and girls in families of six children, conform more closely to subjects' conceptions of randomness than others that are in fact equally likely. The results, however are equally consistent with the tendency to underestimate combinatorial possibilities studied by the same authors (Tversky & Kahneman, 1973). Under this interpretation, subjects begin with the correct observation that families of three boys and three girls are more common than families of five boys and one girl. They then err, however, by underestimating the number of different possible exact birth orders of three boys and three girls relative to that of five boys and one girl. This results in erroneous estimates of the number of instances likely to be associated with each exact order, and the subsequent incorrect judgment that the given exact order of five boys and one girl is less common than the given exact order of three boys and three girls. The general point of this example is that there is so much uncertainty about what subjects are doing in such tasks, given that they may restructure or alter the meaning of information and instructions given to them, that the evidence cannot be said to point unequivocally to a particular judgmental heuristic.

All of these specific points of re-interpretation conform to the general principle that subjects are attempting to behave in ways adaptive to practical concerns and the nature of social reality, rather than as good statisticians. Even if people were to aspire to statistical optimality, statistical standards are rarely available in real life and are, therefore, not merely impractical but also impossible criteria to use.

Nevertheless, a judgment must at least be consistent with the information on which it is

based: this is the only readily available criterion of accuracy, and it is also a practical one, for anyone who obviously fails to meet it will suffer loss of face, if not other practical disadvantages. Generally, attempts to explain or judge will cease when an outcome is obtained that meets this "fitting" criterion: exceptions to this may occur when other practical concerns are equally, or more, salient.

An interesting case of the fitting criterion in conflict with statistical theory concerns lay ignorance of regression effects. Regression effects will remain unknown if the changes in performance that constitute them can have an explanation of some kind "fitted" to them, and, as the examples given by Kahneman and Tversky (1973) show, this is what happens: not only do explanations given for regression effects meet the fitting criterion but also they are hard to disprove. In fact many of them may actually be correct. The performance of a basketball player, for example, is not a matter of randomness, but is the outcome of complex determining factors; and it is, therefore, not incorrect to attempt to explain the level of performance achieved on any one occasion, or to select such an explanation in a manner which contrasts it with some earlier performance. The errors people make are errors of causal analysis (such as ascribing causal force to factors that do not possess it, or referring to the regression effect itself, as if it were a causal factor — e.g. explaining a change in performance as due to "sophomore slump" — Nisbett & Ross, 1980). It makes practical sense to attempt causal analyses in such cases. It does not make practical sense, however, to conceptualise changes in performance as purely statistical phenomena. Regression effects occur not because the events involved are genuinely probabilistic, but because the causes operative on different occasions are at least partly independent and independently variable. In fact, people may possess some appreciation of regression phenomena, exemplified in such sayings as "He couldn't keep it up forever" and, possibly, in the gambler's fallacy. The fact that this understanding is often not applied when it could be, and sometimes applied when it should not be, is due to the need for practicality and to the lay tendency to be satisfied with mere explanation-fitting.

Factors that are salient are those that relate to current practical concerns. Practical concerns vary across both times and individuals, so there is no universal agreement as to which factors or features are, and are not, salient. We never form beliefs or judgments in isolation from circumstances or considerations of practicality. But the representativeness heuristic lacks predictive power because there is no definition of salience in it. Since it can only be used when populaton information is available, it is both limited in scope and unpopular with laypeople, who do not use population information to make inferences.

The Limited Value of Statistical Theory

Normative statistical procedures are probably optimal for a narrow range of specific judgments made by statisticians and scientists, because they involve minimal risk and specify degrees of uncertainty associated with data. However, adherence to statistically normative criteria would prove a handicap to any judgment under uncertainty that does not fall within that narrow range, or that is not made by a scientist or statistician. The most significant intellectual leaps of judgment are made not with the aid of statistical theory but with the aid of methods that, while popular with laypeople, are derogated by psychologists and statisticians as suboptimal and biased.

Let us take as a convenient example the development of the philosophy of Rousseau. While one could dispute the correctness of Rousseau's opinions, nevertheless he was a profound and original thinker who exerted considerable influence on the transition from the Age of Reason to the Age of Romanticism and nature-worship. The development of Rousseau's philosophy was greatly promoted by a single, vivid, personal experience — an experience, as it happens, of oneness with nature (Clark, 1969). Rousseau made a connection between this most particular and the most general levels, not by obtaining an adequate sample of instances, but by making a realization based on one instance. The experience sampled was not the most representative but the most extreme, and as such the most valuable and significant for his purposes.

Rosseau's experience was transitory. What was influential for him was his memory of it and of the thoughts he had had about it. These would have served him, then and afterwards, as a flexible and complex component in what would now be referred to as a mental set or problem rep-

resentation (Evans, 1983), or series of them, helping to select and shape the further thoughts he would have had during the development of his ideas. Mental set is a means of organizing experience in thought, a means in fact of sampling information in a way completely at odds with the criterion of statistical adequacy and representativeness, and conventionally derogated in psychology for its rigidity, bias and narrowness and counter-productiveness. Yet in this case it would have served a useful role in the development of a novel world view.

Finally, Rousseau is unlikely to have confined his beliefs to one instance or memory. In testing out the validity of his ideas, or in anything he did that could be considered analogous to that, Rousseau is likely to have used a confirmatory testing strategy, seeking out or attempting to re-create further experiences of the same kind. Confirmatory testing appears to be ubiquitous in human judgment (Wason 1960, 1968; Wason & Johnson-Laird, 1972; Snyder & Swann, 1978; Snyder & Campbell, 1980; Snyder, 1981) and is ubiquitously regarded as suboptimal. In fact, confirmatory testing serves two useful purposes in the context of beliefs formed, as most are, on small samples of information. It provides a means of rejecting those based on coincidence or illusion, and it tests not the truth or falsity of a belief so much as its realm of applicability, a concept more relevant to scientific hypotheses than psychology has tended to acknowledge.

What matters about Rousseau's ideas is not whether they were right or not, but how valuable they were: what mattered in his personal experience was not its statistical power, but its contribution to the development of ideas. Rousseau could not have produced work of genius with the aid of totally inadequate sampling, mental set and confirmatory testing, if these things were never more useful than statistically optimal procedures. The inspired selection and use of a single case or instance is as crucial to the success of a chess grandmaster as to a great thinker (de Groot, 1965). Statistical sampling and other normative statistical and scientific procedures are too conservative and slow a means of progress. To regard them as optimal criteria for the assessment of judgment under uncertainty is a symptom of the conservative malaise of trusting a tool more than its user. Statistical methods are suboptimal for those without statistical training, because of the dangers of misuse; they are suboptimal for individuals of talent because they deny talent its proper role.

The correct criterion for judging the quality of lay reasoning is that of the extent to which the outcomes of reasoning satisfy the concerns operative for the judge at the time: the criteria of logical, statistical and scientific optimality should be reserved for the particular range of judgments made by logicians, statisticians and scientists. The study of human judgment has become narrow and distorted by looking only at trivial judgments, by looking at them from a scientific point of view, and by considering judgment a thing in itself rather than a component in an integrated, purposive exploration of reality by an individual.

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