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Bias in Judgment: Comparing Individuals and Groups

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The relative susceptibility of individuals and groups to systematic judgmental biases is considered. An overview of the relevant empirical literature reveals no clear or general pattern. However, a theoretical analysis employing J. H. Davis's (1973) social decision scheme (SDS) model reveals that the relative magnitude of individual and group bias depends upon several factors, including group size, initial individual judgment, the magnitude of bias among individuals, the type of bias, and most of all, the group-judgment process. It is concluded that there can be no simple answer to the question, "Which are more biased, individuals or groups?," but the SDS model offers a framework for specifying some of the conditions under which individuals are both more and less biased than groups.

A great deal of research in social and cognitive psychology has been devoted to demonstrating what is probably an uncontroversial proposition: that human judgment is imperfect. What makes this work interesting and useful is that such imperfections often constitute more than random fluctuations around "rational," prescribed, or ideal judgments. Rather, humans consistently exhibit systematic biases in their judgments. Some of these biases seem to stem from self-enhancing or self-protective motives (e.g., Greenwald, 1980; Myers, 1980). Others may stem from general cognitive shortcuts or heuristics (e.g., Kahneman, Slovic, & Tversky, 1982). Still others seem to reflect an inappropriate sensitivity or insensitivity to certain types of information (e.g., underuse of base-rate information; Kahneman et al., 1982; Nisbett & Ross, 1980). Regardless of their sources, systematic judgmental biases can have serious consequences (cf. Dawes, 1988; Thaler, 1991), and identifying means of controlling such biases is an important challenge for psychology.

These questions have largely been the province of scholars of cognition, social cognition, and judgment and decision making, all of whom have understandably focused primarily upon the behavior of the individual judge. However, in many important instances, the judges who are potentially vulnerable to such systematic biases are groups rather than individuals. For example, typically juries (not individual jurors) must decide guilt or innocence; Congress (not individual lawmakers) must declare war; boards of directors (not individual directors) must decide corporate policy. In this article, we (as social psychologists) explore the following question: Are decision-making groups any less (or more) subject to judgmental biases than individual decision makers? For example, might we expect deliberating juries to be any less (or more) sensitive than individual jurors to proscribed extralegal information, such as the race of a victim? Our goal is to shed light on when groups are more biased than individuals, when individuals are more biased than groups, and most importantly, whether and why there are patterns in such comparisons.

We begin by discussing the concept of judgmental bias and advancing a simple taxonomy of bias effects. We then present an overview of the relevant empirical literature: namely, those studies that compare individual and group susceptibility to particular types of bias. This overview will demonstrate that there is no simple and general pattern in the literature. We then suggest that formal models that link individual and group judgment can usefully be applied to a theoretical analysis of this question. Davis' (1973) *social decision scheme* (SDS) model of group decision making is proposed as a promising basis for such an analysis. The parameters of the SDS model are then linked conceptually to information processing by individuals and by groups (Hinsz, Tindale, & Vollrath, in press). A small set of generic group-judgment processes are then identified from past theory and research using the SDS model. The effects of each of these processes for each type of bias are then explored within a series of "thought experiments" (Davis & Kerr, 1986), in which a number of variables of interest (e.g., group size; magnitude of individual bias) are systematically manipulated. When feasible, these thought experiments are augmented with relevant empirical illustrations of predicted patterns. Finally, an additional source of individual–group differences in biased judgment is

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identified (and illustrated in prior research)—instances in which possession of certain information alters the group decision-making process itself.

Bias and Its Varieties

Defining (Systematic) Bias

We begin by defining what we mean by biased judgment. The concept of biased judgment assumes that one can specify a non-biased standard of judgment against which actual human judgments can be compared (Funder, 1987; Hastie & Rasinski, 1988). The basis of that standard, the *normative model* of judgment, may be some formal logical system (e.g., syllogistic logic, probability theory, game theory, rational choice models). However, the normative model may also be based on convention. Good examples of the latter types of standards are the common law rules of evidence that proscribe jurors' use of certain information (e.g., a defendant's race or gender or physical appearance). It is not our purpose here to defend any particular normative models of judgment as ideal or unbiased nor is it to propose conditions for such normative models that are generally necessary or sufficient (see Hastie & Rasinski, 1988, for a discussion of related issues). Rather, we focus on a number of judgmental phenomena for which there are both reasonable and defensible normative models and convincing empirical demonstrations of bias, and we address the theoretical and empirical issue of whether individuals or groups are relatively more likely to exhibit those biases.

Our focus will be on systematic departures from a standard of judgment (i.e., patterned or orderly deviations from the normative standard; Einhorn, Hogarth, & Klempner, 1977; Funder, 1987). Thus, we will not be concerned here with individual versus group differences in the magnitude of unsystematic random error, in the consistency with which valid cues are applied or in ability to learn from diagnostic feedback (e.g., see Chalos & Pickard, 1985; Davis, Kerr, Sussmann, & Rissman, 1974; Einhorn et al., 1977; Laughlin & Shippy, 1983; Laughlin & Sweeney, 1977; Zajonc, 1962).

A Taxonomy of Systematic Biases

Hastie and Rasinski (1988) suggest that there are several distinctive logics for establishing a systematic bias in judgment. Their taxonomy of bias differs from others in the literature in that it distinguishes methods for demonstrating bias, rather than task domains (e.g., Pelham & Neter's, 1995, distinction between biases in persuasion vs. person perception vs. judgment under uncertainty) or the psychological origins of biases (e.g., Arkes', 1991, distinction among strategy-based, association-based, and psychophysically based errors). In this article, we will be concerned with three of Hastie and Rasinski's types of bias.

Judgmental Sins of Imprecision

The first and most straightforward type of bias is revealed by a direct comparison between judgment and criterion. A familiar example is research demonstrating that judges rarely alter their subjective probability judgments as much in response to new, diagnostic, and probabilistic information as Bayes' theorem prescribes (Edwards, 1968). Another example (of which we will make repeated use later) comes from research on prospect theory (Kahneman & Tversky, 1984). Participants are asked to choose between two courses of action with identical expected values (under an assumption of a linear utility function, such that the value of the n'th unit gained or lost is equal to the value of the first such unit). Unbiased judgment should result in indifference between the two choices. However, Kahneman & Tversky (e.g., 1984) have shown that this choice is biased by the way in which the choices are described or "framed"; for example, participants generally preferred Choice A with uncertain loss to Choice B with certain loss, but also prefer Choice C with certain gain over Choice D with uncertain gain (or, to use the customary terminology, participants seem to be risk seeking when the outcomes are framed as losses and to be risk averse when the outcomes are framed as gains). The magnitude of such a bias in judgment might be indexed by how much more popular Choice A was (e.g., percentage of participants choosing A) than the prescribed baseline (viz., participants preferred Choice A 50% of the time, indicative of indifference between A and B). Unbiased judgment in this example prescribes a specific and precise use of available information (viz., computation and comparison of expected utilities); biased judgment reflects systematic departure from this prescribed and precise use of information. For this reason, we will term this type of bias a judgmental *sin of imprecision* (SofI; Hastie & Rasinski, 1988, refer to such a contrast as a "direct assessment of criterion-judgment relationship").

At this point, we might introduce some useful notation. Let us suppose that the judgment task posed to individuals requires participants to choose among n possible responses. For example, in the prospect theory paradigm just discussed, researchers asked participants to choose between two outcomes (one certain and the other uncertain). We shall denote the distribution of individual judgments or decisions across these n alternatives with the vector $\boldsymbol{p} = (p_1, p_2, \ldots, p_n)$. In order for investigators to document that a judgmental sin of imprecision has occurred among individual judges, they must first specify how the judgments of perfectly unbiased individuals should be distributed. We shall denote this ideal criterion distribution as $\boldsymbol{I}$; for example, in our prospect theory example, $\boldsymbol{I} = (.5, .5)$. Unbiased judgment would require that (within the limits of sampling error) $\boldsymbol{p} = \boldsymbol{I}$; when $\boldsymbol{p} \neq \boldsymbol{I}$, bias would be indicated. In the latter case, the magnitude of the bias displayed by individual judges (b) could simply be indexed by $b = |\boldsymbol{p} - \boldsymbol{I}|$, where $|\boldsymbol{p} - \boldsymbol{I}|$ denotes the length of vector $(\boldsymbol{p} - \boldsymbol{I})$. (Of course, the direction in which judges depart from the criterion may also be important in understanding the causes of the biased judgment, but a simple scalar index of the magnitude of bias will be sufficient for the purposes of this article.) Thus, the assertion that individuals exhibit a sin of imprecision would require evidence justifying a rejection of the null hypothesis $H_0\colon b = 0$.

Now, in a like manner, we could ask r-person groups to perform the identical judgment task (e.g., we could ask 4-person groups to choose between certain and uncertain losses). Using upper-case letters to denote group variables, the magnitude of bias among group judges (B) would just be $B = |\boldsymbol{P} - \boldsymbol{I}|$, where $\boldsymbol{P} = (P_1, P_2, \ldots, P_n)$, the distribution of group judgments. Our primary interest in this paper is estimating and explaining the relative magnitude of individual and group bias. This may be indexed by RB = relative bias = $B - b$. When $RB = 0$, then groups and individuals exhibit an identical degree of bias. When $RB > 0$, groups are relatively more biased than individual judges; and when $RB < 0$, groups are relatively less biased than individuals.

Judgmental Sins of Commission

A key feature of a sin of imprecision is that the no-bias criterion is defined theoretically and the magnitude of bias is defined by the discrepancy between that criterion and human judgment.[1] The other two types of bias that we will consider use an empirical rather than a theoretical no-bias criterion. In one such type of bias, which we will term a judgmental *sin of commission* (SofC; and Hastie & Rasinski, 1988, call "use a bad cue"), the model of ideal, unbiased judgment holds that certain information is irrelevant or nondiagnostic for the required judgment. For example, the rules of evidence usually require that an unbiased juror pay no attention to a victim's race or a defendant's physical attractiveness in deciding whether or not the defendant is guilty. Bias is manifest when jurors use such information. This typically involves comparison of a condition in which the potentially biasing information is provided (e.g., jurors considering a stimulus trial with a physically attractive defendant) with a control condition in which either this information is missing (e.g., no information provided on defendant attractiveness) or different information is provided (e.g., the defendant is physically unattractive). We might call the former, experimental condition the high-bias condition and the latter, control condition the low-bias condition. A sin of commission has occurred when the judgments in these two conditions differ significantly.

Extending our earlier notation, a sin of commission by individual judges requires that the judgments of individuals in the high- (H) and low- (L) bias conditions differ, that is, $\boldsymbol{p}_H \neq \boldsymbol{p}_L$ (where $\boldsymbol{p}_H$ and $\boldsymbol{p}_L$ are the distributions of individual judgments in the high- and low-bias conditions, respectively) and, hence, that $b = |\boldsymbol{p}_H - \boldsymbol{p}_L|$ be greater than zero. A corresponding bias among groups would mean that $\boldsymbol{P}_H \neq \boldsymbol{P}_L$ (where $\boldsymbol{P}_H$ and $\boldsymbol{P}_L$ are the distributions of group judgments in the high- and low-bias conditions, respectively) and that $B = |\boldsymbol{P}_H - \boldsymbol{P}_L| > 0$. Again, in this article we are primarily interested in the relative magnitude of individual and group bias, $RB = B - b$.

It is worth noting that sins of imprecision can be documented using a sin of commission methodology. For example, rather than establishing the prospect theory's risk-seeking bias by comparing the popularity of the risky alternative with a chance, 50% baseline, one might instead compare the level of preference for the risky alternative in a condition using a loss frame with the same preference in a second condition utilizing a gain frame (e.g., see McGuire, Kiesler, & Siegel, 1987). This alters the goodness-of-fit statistical logic used when establishing a sin of imprecision to the more typical null hypothesis testing statistical logic used when establishing the other two types of judgmental sins (Hastie & Rasinski, 1988; Meehl, 1990). We note all this because, as we will show later, how one decides to demonstrate bias can affect the comparison of individual and group bias.

Judgmental Sins of Omission

We will term the third and final type of bias a *sin of omission* (SofO; what Hastie & Rasinski, 1988, call "miss a good cue"). This occurs when the judge fails to use information held to be diagnostic by the idealized model of judgment. For example, many studies have shown that judges frequently fail to use diagnostic base-rate information (see Nisbett & Ross, 1980). Likewise, people also tend to ignore situational constraints when explaining an actor's behavior (the correspondence bias, see Nisbett & Ross, 1980); for example, participants who read a written essay tend to ignore whether or not the writer chose voluntarily to take that position versus was randomly assigned that position when judging the writer's true feelings on the essay's topic (Jones & Harris, 1967).

A sin of omission has occurred when conditions differing on the availability of such useful information fail to produce reliably different judgments (e.g., no difference in judgment between participants given different levels of base-rate information). If we again refer to conditions differing in the availability of this prescribed information as the high and low conditions, then a sin of omission by individual judges requires that $\boldsymbol{p}_H = \boldsymbol{p}_L$ (where $\boldsymbol{p}_H$ and $\boldsymbol{p}_L$ are the distributions of individual judgments in the high and low conditions, respectively). Since it is the absence of an effect that signifies bias for this type of sin, the magnitude of differences in judgment between these conditions (i.e., $b = |\boldsymbol{p}_H - \boldsymbol{p}_L|$) serves to index not the magnitude of bias, but rather a lack of bias. So for a sin of omission to obtain, $b = 0$. Likewise, a sin of omission among groups would mean that $\boldsymbol{P}_H = \boldsymbol{P}_L$ and, thus, that $B = |\boldsymbol{P}_H - \boldsymbol{P}_L|$ should be zero. The reversal from the logic of detecting sins of commission requires that we reverse the terms in the definition of the relative magnitude of a SofO bias. That is, for sins of omission, $RB = b - B$ (instead of $B - b$, as in the SofI and SofC cases). When relative bias for the SofO case is defined in this way, positive values of relative bias still signify that groups are relatively more biased than individuals.[2]

[1] The criterion need not necessarily be a specific point value. For example, the conjunction error (Tversky & Kahneman, 1983) is indicated by a judgment falling anywhere above a maximum value specified by probability theory.

[2] In the text, we have made the simplifying assumption that the larger the difference between the high- and low-bias conditions, the more "accurate" judges are (i.e., the more appropriately they are using the available information). Of course, theoretically it is possible to specify not only that certain information should be used, but precisely how much of an impact such information should have. For example, not only should judges pay attention to base-rate information, but using certain normative models (e.g., Bayes' theorem), it is possible to specify exactly how much impact any particular piece of base-rate information should have. In such a case, it is also possible that bias could be revealed by judges paying too much attention to the information in question as well as too little. In such a case, one could not simply assume that the larger RB was, the more biased groups were relative to individuals. However, this theoretical complication does not negate the thrust of the present analysis (which makes the simplifying assumption that the more one uses prescribed information, the better).

Other Conceptions of Bias

Because theory and research on judgmental bias has grown so explosively over the past two decades, some further taxonomic distinctions will help bound our coverage of the topic.

First, we have excluded from our analysis a fourth logic for demonstrating bias described by Hastie and Rasinski (1988). This logic involves a comparison of the judgments reached by two or more sets of judges (e.g., men and women). In tasks where a single unbiased judgment can be assumed, reliable differences in judgment between such sets of judges implies that at least one of them is inaccurate (i.e., biased). In our present context, this logic can be readily generalized to comparisons of judgments by sets of groups instead of sets of individuals.

This logic may be used to examine what Kaplan and Miller (1978) call *trait biases,* that is, biases attributable to some stable characteristic or disposition of the judge. For example, mock jury studies have compared verdicts reached by sets of jurors classified as high versus low on traits like authoritarianism (Bray & Noble, 1978) or on prior beliefs about the probability that any given rape defendant is guilty (Davis, Spitzer, Nagao, & Stasser, 1978).

This fourth logic can be useful for probing the nature and consequences of traits, but we exclude it from our present analyses of bias because of its inherent inferential ambiguity. The mere fact that judgments by two or more sets of judges are reliably different is typically insufficient to unambiguously establish that nonnormative use of information has occurred. It is often possible, for example, that the judgment processes of the sets of judges differ in ways permitted by or irrelevant to the normative model of judgment. For example, jurors have broad discretion in evaluating the credibility of witnesses. Sex differences in trial verdict could simply reflect sex differences in the perceived credibility of a key witness, an effect that might not violate any normative model of juror judgment. Moreover, even if such problems could be avoided (e.g., by using tasks where the normative model prescribes that and how all available information is used), the locus of bias remains ambiguous under this logic; disagreement between two sets of judges could mean that one, the other, or both are making biased judgments. Thus, in the remainder of this article, we limit our analysis to cases involving the other three Hastie–Rasinski (1988) logics or what we have labeled judgmental sins of imprecision, commission, and omission.

An additional distinction involves group composition: specifically, the degree of homogeneity or heterogeneity in the group. Though group homogeneity often refers to the distribution of a personality or demographic trait across members, for our purposes it is defined with respect to exposure to information. Thus a homogeneous group is one in which each member of a group has been exposed to the same prescribed, proscribed, or neutral information set, although members may nevertheless differ with respect to their attention, encoding, and recall of that information. In a heterogeneous group, members differ quantitatively in their amount of exposure to the stimulus or qualitatively in the particular biasing stimuli to which they have been exposed (e.g., Kameda & Davis, 1990; Tindale, Sheffey, & Scott, 1993). Although we limit our analysis to cases involving homogeneous groups, at the conclusion of the article we briefly examine how heterogeneous grouping might influence the individual–group comparison (see Kerr & Huang, 1986; Tindale & Nagao, 1986).

Furthermore, our analysis does not address other senses in which individual and group decision processes may be more or less biased; for example, with respect to the representation of diverse viewpoints in the community, the perceived fairness of decision rules and the perceived legitimacy of the decision maker's mandate (see MacCoun & Tyler, 1988). We also limit our review and analysis to the potentially moderating effects of discussion in face-to-face small groups. Thus, we exclude the growing body of research in the experimental market paradigm, which examines the effects of simulated market transactions on the rationality of individual choice (see reviews by Camerer, 1992; Plott, 1986). Two characteristics generally distinguish that paradigm from the small-group paradigm examined here: In the former, judges generally make repeated individual choices without explicit group discussion, and they receive feedback on the effects of their choices, although that feedback is often lagged, noisy, and highly interdependent on the influences of other judges and exogenous factors (see the essays in Hogarth, 1990).

Finally, although this article's focus is upon biased use of information, it is important to recognize that there is nothing in our analysis of sins of omission or commission that requires this limitation. That is, our primary question could be rephrased from "are groups any less (or more) subject to SofC or SofO judgmental biases than individuals?" to "are groups any less (or more) likely to use a particular piece of information than individuals?"[3] Our presentation is couched within the framework of biased judgment (i.e., proscribed use of information), but it is worth remembering that the same analysis can be applied with profit to comparing unbiased judgment by individuals and groups. We return to this important point later.

Summary

Three qualitatively different forms of judgmental bias have been distinguished: differences between judgment and a particular judgment prescribed by a normative model (a sin of imprecision); differences in response to the availability of information that should be ignored by judges (a sin of commission); and failures to observe differences in judgment due to the availability of information that should be used by judges (a sin of omission).

In the following section we provide an overview of the relevant empirical literature, cross-categorized by the three types of bias defined above. This taxonomy of biases, per se, does not simply organize that literature. It is not the case, for example, that groups tend generally to be more biased than individuals for one type of bias, but less biased for another. However, distinguishing between these different types of bias is very useful for our subsequent theoretical analyses and for fitting particular empirical findings within those analyses.

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[3] Thanks to Reid Hastie for making this important point.

Overview of Relevant Prior Research

Coverage

Several review essays have done an excellent job of comparing individual and group performance on various decision tasks (see Einhorn et al., 1977; Hastie, 1986; Hill, 1987; Laughlin & Ellis, 1986; McGrath, 1984; Vollrath, Sheppard, Hinsz, & Davis, 1989). The general consensus is that, on average, groups outperform individuals on such tasks, although groups typically fall short of the performance of their highest-ability members. These reviews have generally equated the quality of performance with accuracy, defined in terms of the distance between individual or group judgments and a value (e.g., judgments of weight or distance, arithmetic problems), what we have called sins of imprecision (see Hastie, 1986; Hastie & Rasinski, 1988). The accuracy criterion is most applicable to what Laughlin (e.g., Laughlin & Ellis, 1986) calls intellective tasks; that is, tasks where clear criteria exist for evaluating the quality of cognitive performance. But whether a task can be characterized as intellective depends on several factors: the existence of a normative theory of the task, the degree to which knowledge of the theory is shared by group members, and the degree to which the theory, once voiced, is accepted as valid by group members (Laughlin & Ellis, 1986; McGrath, 1984). Where previous reviews have focused primarily on tasks that are unambiguously intellective (e.g., arithmetic problems, deductive brain teasers, simple recognition and recall memory) most of the studies we review fall within a "grey area" marking the transition from pure intellective tasks to pure decision-making (McGrath, 1984) or judgmental (Laughlin & Ellis, 1986) tasks: tasks that have no demonstrably correct answer. Of course, when bias is a sin of commission or omission, it is not necessary that a task be clearly intellective. Bias can be demonstrated without recourse to a correct answer by comparing the performance of decision makers operating under alternative experimental conditions that should or should not, in a normative sense, influence outcomes. Besides their recurrence in the literature, what makes such studies interesting is that, in keeping with the quasi-intellective nature of their tasks, the normative standards for identifying bias may not be readily obvious to all decision makers.

Methodological Caveats

Comparisons of statistical significance levels across levels of analysis—individual versus group—can be hazardous. In many repeated-measures studies, the sample size at the group level of analysis is only $(1/r)$th as large as the individual-level sample size, where r is the group size. This implies that group-level effects will generally be tested at a much lower level of statistical power, and thus reliable individual effects might not be detected at the group level even when of equal or greater magnitude (Kenny, Kashy, & Bolger, in press). Thus, differential statistical power can artifactually make groups appear less biased than individuals with respect to sins of commission, where a null finding implies the absence of bias. It can make groups appear more biased than individuals with respect to sins of omission, where a null finding implies the presence of bias.

Ideally, one might compensate for studies with low statistical power by conducting a meta-analysis of the effects of group discussion on particular judgmental biases, but that goal seemed neither feasible nor appropriate given the paucity of available data. We have been able to locate fewer than 30 different empirical studies that directly examined both individual- and group-level biases. Across these studies, there is little consistency in decision tasks, procedures, group sizes, independent variables, dependent measures, and inferential statistical tests; in such cases, meta-analyses could not only be inappropriate, but quite misleading. Moreover, studies varied in their implementation of the individual–group comparison. In some studies, participants were randomly assigned to either an individual or a group condition in a between-subjects design, while other studies compared prediscussion, group-level, and postdiscussion judgments in a repeated-measures design. Many of these studies failed to report either explicit statistical tests of the individual–group comparison or the information needed to conduct such tests. Finally, our theoretical analysis, presented later, suggests that existing research provides quite spotty coverage of the relevant parameter space; as such, overgeneralization from observed empirical patterns provides a potentially misleading comparison of individual and group bias.

An Overview of Relevant Research

In Table 1, we use our trichotomous bias taxonomy (i.e., sins of commission, omission, or imprecision) to categorize the existing literature on individual versus group bias. We should emphasize that such a categorization is quite broad and almost certainly glosses over important psychological distinctions among judgmental phenomena. Indeed, the taxonomy's immediate purpose is to categorize experimental operations; whether it also categorizes distinct psychological process is an open question we explore throughout the article.

Across the three general types of bias we distinguish 15 judgmental phenomena that (a) seem to produce bias among individuals and (b) have been studied so as to permit some comparison of the relative susceptibility of individuals and groups to that bias. Eight of these can be classified as judgmental sins of commission: framing bias (e.g., Kahneman & Tversky, 1984; Tversky & Kahneman, 1981); preference reversals (i.e., inconsistencies in judgment across alternative ways of obtaining judgments; e.g., Lichtenstein & Slovic, 1971; Tversky, Sattath, & Slovic, 1988); theory-perseverance effects (i.e., overreliance on information that might once have been but is no longer diagnostic; e.g., Anderson, Lepper, & Ross, 1980; Nisbett & Ross, 1980); oversensitivity to irretrievable, "sunk" costs (e.g., Arkes & Blumer, 1985; Brockner & Rubin, 1985); jurors' use of legally irrelevant, extraevidentary information (see Dane & Wrightsman, 1982); nonindependence of judgments by jurors in trials with multiple, joined charges (e.g., Greene & Loftus, 1985); biasing effects on juror judgment of spurious attorney arguments (e.g., Wells, Miene, & Wrightsman, 1985); and the hindsight bias (e.g., Hawkins & Hastie, 1990). Three more phenomena can be classified as judgmental sins of omission: insensitivity to base-rate information (e.g., Kahneman, Slovic, & Tversky, 1982); underuse of situational information when making behavioral attributions, variously termed the dispositional bias, correspondence bias, or the fundamental attribution error (e.g., Jones & Harris, 1967; Nisbett & Ross, 1980); and

Table 1
Classification and Summary of Empirical Literature

Phenomenon	Studies	General effect of discussion
	Sin of commission	
Framing	Tindale et al. (1993)Ø[1] Kameda & Davis (1990)Ø[1] McGuire et al. (1987)↑ Paese et al. (1993)= Neale et al. (1986)↓	Mixed: Group discussion amplified bias in McGuire et al., attenuated bias in Neale et al., no effect in Paese et al.
Preference reversal	Mowen & Gentry (1980)↑ Irwin & Davis (1995)↓	Mixed: Groups more susceptible to choice/rank reversals but less susceptible to choice/match reversals than individuals.
Theory-perseverance effect	Wright & Christie (1990)↓Ø[2]	Attenuation: Theory-perseverance effect eliminated in group-discussion and yoked-transcript conditions (but see Note Ø[2]).
Weighing sunk costs	Whyte (1993)↑	Amplification: Groups were more influenced by the existence of past, sunk costs than individuals.
Extraevidentiary bias in juror judgments	Bray, Struckman-Johnson, Osborne, McFarlane, & Scott (1978)Ø[2] Carretta & Moreland (1983)Ø[2]?[1] Hans & Doob (1976)↑ Izzett & Leginski (1974)Ø[2,3] Kaplan & Miller (1978)↓ Kerwin & Shaffer (1994)Ø[4] Kramer et al. (1990)↑ MacCoun (1990)↑ Thompson et al. (1981)= Zanzola (1977)↑	Mixed: Amplification is more common than attenuation.
Joinder bias in juror judgments	Tanford & Penrod (1984)= Davis et al. (1984)=	Mixed: No clear effect of group discussion.
Biasing effect of spurious attorney arguments	Schumman & Thompson (1989)↑	Amplification: Groups more susceptible than individuals.
Hindsight bias	Stahlberg, Eller, Maass, & Frey (1995)↓	Attenuation: Groups slightly less susceptible than individuals.
	Sin of omission	
Insensitivity to base rates	Argote, Seabright, & Dyer (1986)↑?[2] Argote, Devadas, & Melone (1990)↕?[2,3] Nagao, Tindale, Hinsz, & Davis (1985)↕?[2]	Mixed: Good evidence that groups rely more heavily on individuating information, but no direct evidence that they rely less on base-rate information (and some to the contrary; see ?[3]).
Dispositional bias in attributions	Wright & Wells (1985)↓ Wittenbaum & Stasser (1995)↓	Attenuation: Appears that group discussion attenuates dispositional bias.
Underuse of consensus information in attributions	Wright et al. (1990)↓	Attenuation: Only group participants were affected by consensus information.
	Sin of imprecision	
Conjunction error	Tindale, Sheffey, & Filkins (1990)↕ Tindale, Filkins, Thomas, & Smith (1993)↕	Mixed: Groups made more conjunction errors than individuals when individual error rates were high, but fewer when individual error rates were low.
Use of representativeness heuristic	Stasson, Ono, Zimmerman, & Davis (1988)$\cancel{\uparrow}$	Amplification? Individuals outperformed groups on one problem; no difference for second problem.
Use of availability heuristic	Stasson et al. (1987)↓	Attenuation?: Groups (especially when unanimous) marginally out-performed individuals.
Overconfidence (miscalibration)	Dunning & Ross (1992)↑ Sniezek & Henry (1989)↓ Plous (1995)=	Mixed: Groups are generally more confident than individuals, but whether this reflects overconfidence varies between studies.

Note. Amplification signifies a stronger bias among groups (or following group discussion) than among individuals (i.e., $RB > 0$). Attenuation signifies a weaker bias among groups (or following group discussion) than among individuals, $RB < 0$. Mixed signifies an inconsistent pattern of findings, such that for certain studies or analyses $RB > 0$, for others $RB < 0$.
↑ signifies that group discussion amplified individual bias.
↓ signifies that group discussion reduced or corrected individual bias.
↕ signifies that there were results indicating that group discussion both amplified and corrected individual bias.
= signifies that the magnitude of bias was comparable for individual and group judges.
Ø signifies that although the study employed both individual and group judges and examined the bias phenomenon, the study's results are not informative for assessing the degree of relative bias for one of the following reasons:
Ø[1] Groups were not homogeneous with respect to exposure to potentially biasing information.
Ø[2] No clear bias effect for individuals for key dependent variables.
Ø[3] Bias observed only on dependent variable for which purported biasing information is not normatively proscribed.
Ø[4] The experimental design did not include a low-bias condition.
Overstruck (e.g., $\cancel{\uparrow}$) or paired (e.g. Ø =) symbols signify combinations of the preceding conditions.
Symbols accompanied by question marks (?) reflect the following methodological or other ambiguities that cloud interpretation of the results:
?[1] Results might be attributed to differential power of statistical tests ($df_{error} = 255$ for individual bias tests but $df_{error} = 30$ for group tests).
?[2] Groups were more prone to use individuating information than individuals, a result that was interpreted as indicating that groups were also less sensitive to base-rate information. However, if the individuating information is diagnostic, one could alternatively conclude that groups make better use of this diagnostic information.
?[3] Access to base-rate information manipulated. When the individuating information was not diagnostic, groups were more likely to use base-rate information; when such information was diagnostic, no reliable effects on relative bias were observed.

underuse of consensus information in attribution (i.e., ignoring information about the proportion of people behaving similarly in a given situation; e.g., Nisbett & Borgida, 1975). Finally, 4 phenomena can be classified as judgmental sins of imprecision: the conjunction error (i.e., when the subjective probability of the conjunction of two events exceeds the minimum of the probabilities of the two isolated events; e.g., Tversky & Kahneman, 1983); use of the representativeness heuristic (i.e., overreliance on some representative or salient, but non-informative, feature of available information; e.g., Kahneman et al., 1982); use of the availability heuristic (i.e., overreliance on information that is readily available; e.g., Kahneman et al., 1982); and overconfidence in own accuracy at all but the most difficult problems (e.g., Lichtenstein, Fischhoff, & Phillips, 1982; Dunning, Griffin, Milojkovic, & Ross, 1990).

In Table 1 we list all those studies that we could identify that made an individual versus group comparison for each of these 15 biases. Unfortunately, certain features of a number of these studies made their results either uninformative or uninterpretable for assessing the degree of relative bias; the nature of these problems are described briefly in the table's footnotes. For each study, the relative degree of bias observed for group versus individual judges is summarized. The table reveals another unfortunate reality: frequently (viz., for 7 of the 15 bias phenomena), there is only one study making the key comparison.

Close inspection of Table 1 does not suggest a simple or coherent picture of the effects of group discussion on biases of judgment. There are several demonstrations that group discussion can attenuate, amplify, or simply reproduce the judgmental biases of individuals. And, although group amplification of bias seems to be the modal result, none of these three patterns appears predominant. Thus, research conducted to date indicates that there is unlikely to be any simple, global answer to the question, "Is group judgment more or less biased than individual judgment?"

In the face of such inconsistent findings, an obvious explanation might be that the effect of group discussion on relative bias is moderated by the nature of the judgmental bias under study. We are convinced that differences among general varieties of bias as well as specific bias phenomena must play an important role in an analysis of relative bias. The remainder of this article is largely devoted to justifying this conviction. Table 1 suggests that our trichotomous bias categorization alone cannot resolve the empirical discrepancies documented in the literature. It is not the case, for example, that groups generally attenuate sins of commission but amplify sins of omission, or vice versa. Rather, for each of these two categories, we find examples of group attenuation and examples of group amplification.

Likewise, comparison and contrast of the studies summarized in Table 1 do not suggest (to us, anyway) any simple task moderators that can organize this diverse literature. For example, two studies of decision framing suggest that groups are even more susceptible to framing than individuals (McGuire et al., 1987; Paese, Bieser, & Tubbs, 1993), yet another finds just the opposite pattern (Neale, Bazerman, Northcraft, & Alperson, 1986). Most studies find that jury deliberation accentuates the effects of extra-evidentiary attributes of trial participants, although one study (Kaplan & Miller, 1978) finds that it attenuates extralegal bias.

No doubt, ad hoc explanations for these discrepancies could be developed, invoking more subtle differences in tasks, procedures, or experimental design. But we believe that a more productive approach would be to start from first principles, building from established and verified theoretical principles regarding the processes by which individual responses are integrated into group judgments. In the following sections, we pursue such a strategy.

A Theoretical Analysis of the Relative Bias of Individuals Versus Groups

Why should groups be any more (or less) susceptible to judgmental biases than individuals? There have been a handful of attempts to provide a theoretical basis for an answer to this question, most in the context of juror versus jury decision making (e.g., Kalven & Zeisel, 1966; Myers & Kaplan, 1976). Most of these imply that bias should be stronger in groups than among individuals (although, see Kaplan & Miller, 1978, for a striking exception).

An Introductory Overview of the Social Decision Scheme (SDS) Model

Our approach to this theoretical problem is to use a formal model that links the product of individual judgment to the product of group judgment. Several such models have been developed specifically for jury decision making (e.g., Gelfand & Solomon, 1974; Klevorick & Rothschild, 1979; Penrod & Hastie, 1980). There are also some more general models that have been applied not just to juries but to other group decision tasks as well (e.g., Davis, 1973, 1980; Hoffman, 1979; Vinokur & Burnstein, 1973). Here we use one particularly influential model of the latter type—Davis' (1973, 1980) social decision scheme (SDS) model. (See Stasser, Kerr, & Davis, 1989, for a general introduction to the SDS model and its progeny; Davis, 1996; Kerr, 1981, 1982; Stasser & Davis, 1981.)

The SDS model suggests that the preferences of group members can be related to group decisions through simple functions, termed social decision schemes. A familiar example is a majority-rules decision scheme, which predicts that the group ultimately settles on the alternative initially favored by a majority of group members. Of course, some groups may not have an absolute majority favoring an alternative at the beginning of deliberation. To deal with such cases, not handled by the primary scheme, one must often posit some subscheme or subschemes (e.g., plurality wins; averaging) along with the primary decision scheme so that all possible distributions of initial preferences are accounted for.

Decision schemes need not be deterministic, predicting one particular group decision with certainty. Rather, they can (and usually are) probabilistic rules. For example, groups occasionally seem to operate under an equiprobability decision scheme for which all alternatives with at least one advocate have an equal chance of being selected as the group decision (e.g., Johnson & Davis, 1972).

Formally, a social decision scheme is a $m \times n$ stochastic matrix D, where n = the number of decision or judgment alternatives and m = the number of possible distributions of r group members across the n decision alternatives. It can be shown (see Davis, 1973) that

$$m = \binom{n+r-1}{r} = \frac{(n+r-1)!}{r!(n-1)!}. \qquad (1)$$

For example, a 12-person jury making a guilty–not guilty choice can be distributed in 13 [=(12 + 2 − 1)!/(12! 1!)] possible ways, namely, (12G, 0NG), (11G, 1NG), ... (0G, 12NG). The d_{ij} element of the D matrix specifies the probability that a group beginning deliberation with the ith possible distribution of member preference will ultimately choose the jth decision alternative. Table 2 presents some possible social decision schemes for 11-person groups choosing between 2 alternatives. (We will soon have more to say about these particular decision schemes.)

All that is required to formally link the distribution of individual judgments or decisions, $(p_1, p_2, \ldots, p_n)$, to the distribution of group decisions, $(P_1, P_2, \ldots, P_n)$, is to link individual preference to the possible initial distributions of opinion in groups. If groups are composed randomly, it follows from the multinomial distribution that the probability, π_i, that the group will begin deliberation with the ith possible distribution, $(r_{i1}, r_{i2}, \ldots, r_{in})$, where $(r_{i1} + r_{i2} + \ldots + r_{in} = r)$, is just

$$\pi_i = \binom{r}{r_{i1} r_{i2} \ldots r_{in}} p_1^{r_{i1}} p_2^{r_{i2}} \ldots p_n^{r_{in}}. \qquad (2)$$

If these probabilities and the distribution of group decisions are expressed as row vectors, $\boldsymbol{\pi} = (\pi_1, \pi_2, \ldots, \pi_m)$ and $\boldsymbol{P} = (P_1, P_2, \ldots, P_n)$, we may relate the distribution of starting points of group decision making, $\boldsymbol{\pi}$, which Equation 2 shows to be a simple function of the distribution of individual preferences, $\boldsymbol{p}$, to group judgments, $\boldsymbol{P}$, with the following matrix–algebra equation:

$$\boldsymbol{P} = \pi D. \qquad (3)$$

As this equation indicates, groups' final decisions depend on two things: (a) where group members begin deliberation, summarized by $\boldsymbol{\pi}$, which depends entirely on individual judgments (see Equation 2) and (b) the processes whereby group members combine their preferences to define a group decision, formally summarized by the social decision scheme matrix, D. The effect of any variable or process that affects the magnitude of relative bias could, in principle, be understood by tracing its effect on where groups begin deliberation, its effect on the process whereby groups reach their decisions, or both. As we shall see shortly, it is useful to distinguish between the simple case in which access to biasing information does not affect the group decision-making process versus where it does. Equation 2 also suggests that if we know how biased individuals are and can make intelligent guesses about the operative social decision scheme, it should be possible to use the SDS model to compare the magnitude of individual and group bias under various conditions of interest (e.g., different types of bias, different-sized groups, different social decision schemes). That is precisely the strategy followed in this article.

Before continuing with our application of the SDS model, we pause to characterize the possible nature of the group processes that are summarized by D.

Individuals and Groups as Information Processors

In this section we explore the question, how does group judgment differ from individual judgment? We attempt to show that every aspect of individual information processing may be al-

Table 2
Alternative Social Decision Schemes

Predeliberation splits		Social decision schemes: Simple majority		Proportionality		Equiprobability		Truth wins[a]		Strong asymmetry[b]	
G	NG	G	NG	G	NG	G	NG	G	NG	G	NG
11	0	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00
10	1	1.00	.00	.91	.09	.50	.50	.00	1.00	.99	.01
9	2	1.00	.00	.82	.18	.50	.50	.00	1.00	.23	.77
8	3	1.00	.00	.73	.27	.50	.50	.00	1.00	.14	.86
7	4	1.00	.00	.64	.36	.50	.50	.00	1.00	.10	.90
6	5	1.00	.00	.55	.45	.50	.50	.00	1.00	.08	.92
5	6	.00	1.00	.45	.55	.50	.50	.00	1.00	.05	.95
4	7	.00	1.00	.36	.64	.50	.50	.00	1.00	.04	.96
3	8	.00	1.00	.27	.73	.50	.50	.00	1.00	.03	.97
2	9	.00	1.00	.18	.82	.50	.50	.00	1.00	.02	.98
1	10	.00	1.00	.09	.91	.50	.50	.00	1.00	.01	.99
0	11	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00

Note. G = guilty; NG = not guilty.
[a] Here, alternative NG is assumed to be "true." [b] Clearly, the asymmetry favors the NG alternative. See Appendix B for information on the function used to generate this D.

tered when groups are making judgments. We hope, thereby, to rectify a common misunderstanding about the nature of social decision schemes and to illustrate the difficulty of precisely specifying D a priori. We then introduce our present analytic approach: to explore the effect of several generic social decision schemes on relative bias.

A common metaphor in cognitive psychology is the human judge as an information processor who is provided with information, processes it in various ways, and outputs a response. A crude schematic model of the individual as information processor (adapted from Hinsz et al., in press) is sketched on the left-hand panel of Figure 1 (Intrapersonal Information Processing). The demands of the judgment task itself provide a context for all stages: They define what is and is not task-relevant information, which intrapersonal cognitive activities can reasonably be seen as task related, and the objective of the judgment task (i.e., task-relevant responses). Between stimulus (information) and response, many intermeshed cognitive activities occur, characterized here (crudely and nonexhaustively) by the processes of attention, encoding, storage, retrieval, and processing (e.g., counterargumentation; see Petty & Cacioppo, 1986) of information. Biased individual information processing is demonstrated by comparing the final response with some idealized criterion (when documenting a sin of imprecision of judgment) or with the responses of other individuals given somewhat different initial information (when documenting sins of commission or omission). In either case however, we can specify how randomly composed groups of size r would begin the process of group judgment (i.e., π), knowing only the outcome of intraindividual information processing (i.e., p). The link from individual judgment, p, to the distribution of prediscussion group member judgments, π, entails only sampling processes, not psychological processes.

When the judge is not an isolated individual but a group of r people, how is the information-processing task altered?[4] Some such changes are represented schematically in the right panel of Figure 1 (Interpersonal/Group Information Processing; see Hinsz et al., in press, and Levine & Resnick, 1993, for a more extensive analysis). First, the demands of the task are broadened. Illustrations of such possible new or altered demands are presented in Appendix A. For example, in the group context, members are often concerned with the task of maintaining or improving interpersonal relationships as well as the task of making a collective judgment (Thibaut & Strickland, 1956). As Janis' (1982) classic work on groupthink indicates, such group task demands can interfere with thorough, accurate judgment in groups. Similarly, group members are likely to be concerned about the impression they create as they contribute (or fail to contribute) to the collective task. In this vein, group discussion or deliberation may vary its style (Hastie, Penrod, & Pennington, 1983), with varying emphasis on thorough exchange and analysis of information versus consistently maintaining and defending one's initial preferences. And, unlike the individual judge, group members must work towards some level of consensus before producing a (collective) response (Miller, 1989; Stasser, Kerr, et al., 1989).

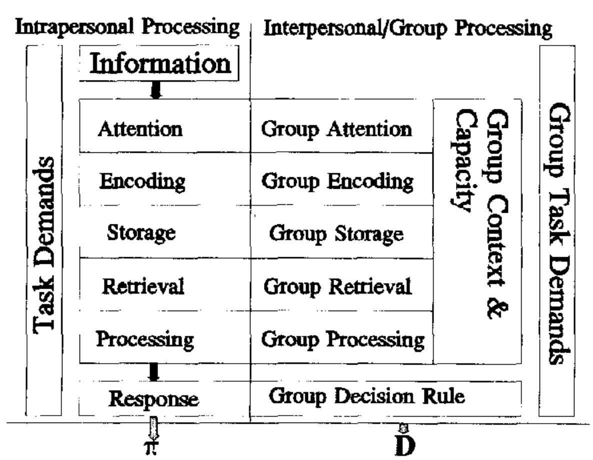

Figure 1. A schematic model of groups as information processors.

Likewise, shifting the judgment task from the individual to the group context potentially may modify every aspect of intraindividual information processing (signified by the regions labeled *Group Attention, Group Encoding,* etc., on the group side of the information-processing box in Figure 1). Some of these modifications stem from certain features of the group performance context; others from the differences between individuals and groups in information processing capacity. Again, Appendix A presents a (nonexhaustive) sampling of some of these potential modifications. For example, attentional processes may be altered because of the distraction created by the group context (Baron, 1986), because there is lowered motivation to attend due to the nonidentifiability of individual contributions to the collective product (Harkins & Szymanski, 1987; Latané, Williams, & Harkins, 1979) or to the possibility that other group members might pick up information that one has missed (Kerr, 1983; Harkins & Petty, 1982), or because the mere presence of other people facilitates simple (and inhibits complex) attentional performance (Zajonc, 1965). The reactions of other group members may also affect how one encodes available information; for example, by priming a schema (Higgins, Rholes, & Jones, 1977) or by providing a socially defined consensus on the meaning of new information (Festinger, 1954). The comments of fellow group members may serve as a cue to assist one's recall of task-relevant information. Obviously, the potential capacity for storage and retrieval of information is greater in the group context (cf. Hartwick, Sheppard, & Davis, 1982), particularly when responsibility for such storage and retrieval is distributed through some type of division of labor (Wegner, 1986). The process of articulating and defending one's position during group discussion may also give group members better access to and awareness of their cognitive processing strategies (much as Ericsson and Simon, 1993, have suggested that individual "talk aloud" or "think aloud" protocols provide more veridical data on cognitive processing than retrospective self reports). On the other hand, the group context can also impede the retrieval of relevant information. For example, Stasser and his colleagues (Stasser & Titus, 1985, 1987; Stasser, Taylor, et al., 1989; Stasser & Stewart, 1992) have shown that information that is unshared

[4] In this discussion, we have drawn liberally from Hinsz et al., (in press). See that article for a focused discussion of related issues.

between group members is (relative to shared information) unlikely to be elicited during group discussion. The group context may also alter the nature of the ultimate processing of available information. Clearly, there are facilitative possibilities, including (a) independent parallel processing of information (cf. Lorge & Solomon, 1955; Taylor, 1954); (b) the elusive "assembly bonus effect" (Tindale, 1992), the combination of different pieces of information that are separately inadequate to produce an accurate judgment but which together make a new, emergent solution possible; (c) fellow members catching and correcting one's errors (Shaw, 1932); (d) random error reduction simply through increasing the number of unbiased judgments being integrated (Zajonc, 1962); (e) for certain tasks, recognition by group members that an argument or position advocated by another group member is self-evidently correct (Laughlin & Ellis, 1986); or (f) the voicing of alternative positions during group deliberation might produce expectancy disconfirmation, which has been shown to undermine judgmental confidence and promote more systematic processing of information (e.g., Maheswaran & Chaiken, 1991). Conversely, some aspects of the group context might impair or further bias processing. For example, recent work on brainstorming (Diehl & Stroebe, 1987) suggests that when other group members are talking, production of one's own ideas is blocked. Or, if the initial, emerging consensus is for an inaccurate judgment, social-comparison processes could derail effective processing.

Finally, even in the rather unlikely event that the r members of the group were to independently process available information in parallel, they would still typically have to resolve differences in judgment to produce a consensual group response. This implicates the full range of social influence processes, from simple conformity to genuine persuasion to accepting a compromise judgment advocated by no group member to acceding to the judgment legitimized by an implicit or explicit decision rule (e.g., majority rules).

The social decision scheme matrix, D, does not (as some have suggested; Myers & Lamm, 1976) simply embody this final, effective social decision rule (i.e., final consensus requirement). Rather, D summarizes the totality of the modifications to information processing resulting from moving from the individual as judge to the group as judge (i.e., to all the processes symbolized on the right panel of Figure 1). Given the current state of knowledge, we cannot even anticipate all possible such modifications, much less specify a priori which such ones may arise and be important for any particular judgmental task. (We will return to a discussion of some such modifications later, though.) What we can do, though, is to identify certain generic social decision schemes that are of theoretical interest, have been shown to accurately summarize the group decision-making process for a sizeable range of interesting tasks, or both. We can then explore theoretically the implications of these Ds for the contrast of bias between individual and group judges.

To simplify our subsequent presentation, we restrict our attention to the simplest possible judgment task: one with only two choice alternatives (i.e., $n = 2$). Because we frequently use jury decision making to illustrate our ideas, we label those two alternatives G and NG (for guilty and not guilty). Although certain interesting processes can arise in cases where the response scale is multichotomous or continuous (Davis, 1996; Kerr, 1992), nearly all of the judgmental biases of interest here can be reduced to the simple dichotomous case by collapsing response categories. We occasionally note when our conclusions need to be qualified by this simplifying assumption.

Alternative Generic Social Decision Schemes

Proportionality D

In this article we focus on four generic social decision schemes. The first, the Proportionality D, is primarily of theoretical interest. This decision scheme assumes that the probability of a particular faction prevailing in the group is equal to the relative frequency of that faction (i.e., $d_{ij} = r_{ij}/r$). The proportionality decision scheme for an 11-person group choosing between two decision alternatives (i.e., $n = 2$, $r = 11$) is included in Table 2. To our knowledge, no research has ever found that a strict proportionality decision scheme actually provided an accurate summary of group decision making at any task (although one can imagine hypothetical social processes that would result in such a decision scheme.[5]). Nevertheless, two things make this decision scheme interesting and worth considering here: (a) its net effect is to reproduce exactly at the group level those judgments observed at the individual level (i.e., $P = p$ under the proportionality scheme); and (b) it serves as a theoretical boundary between two other classes of decision schemes that do have demonstrated empirical utility.

Majority D

The class of decision scheme for which there is the widest empirical support (see Stasser, Kerr, et al., 1989) is the *majority-wins* social decision scheme, of which the simple majority-wins D is a prototype; the ($n = 2$, $r = 11$) case is illustrated in Table 2. It has been shown that such a primary decision scheme (or a close relative like a two-thirds majority wins; cf. Davis et al., 1974) accurately summarizes the decision-making process of groups at many different tasks, including attitudinal judgments (Kerr et al., 1976), duplex bets (Davis et al., 1974), and jury decisions (see Davis, 1980, for a review). Laughlin (e.g., Laughlin & Ellis, 1986) has suggested that such a decision scheme generally applies to group decision making at judgmental tasks, which possess no clear criterion for the correctness of decision alternatives. Many aesthetic, political, ethical, and attitudinal judgments are, in this sense, judgmental tasks. The unifying feature of the generic majority social decision schemes is that they all exhibit "strength in numbers." That is, relatively large factions carry disproportionate influence; formally, if MC = a majority criterion (e.g., $MC = 0.5$ for a simple majority-rules scheme; $MC = 0.66$ for a two-thirds majority-rules scheme), then $d_{ij} > (r_{ij}/r)$ for $r_{ij}/r > \mathrm{MC}$. This reflects the underlying logic of Laughlin's hypothesis: when there is no

[5] For example, the proportionality scheme would summarize a group decision-making process in which groups simply endorsed the initial preference of a single, randomly selected member. Slightly less fanciful would be a process wherein each group member participated equally and the group was equally likely to endorse the position advocated in every argument expressed.

objective basis for evaluating the "correctness" or "accuracy" of a judgment (i.e., no widely shared and easily applied evaluative conceptual system), we must often rely on social consensus to define a valid response (cf. Festinger, 1954).

Equiprobability D

If majority-wins decision schemes exhibit disproportionate strength in numbers and if in a proportionality decision scheme faction strength is exactly equal to its proportional size, then we may also envision decision schemes in which there is little or no strength in numbers (e.g., where $d_{ij} < r_{ij}/r$ for relatively large r_{ij}). One such decision scheme is an equiprobability scheme, in which every alternative with at least one advocate is equally likely to become the group's final choice (see Table 2 for an example). Johnson and Davis (1972) and Davis, Hornik, and Hornseth (1970) found evidence that such a decision scheme accurately accounted for group probability matching judgments. Davis (1982) has speculated that this decision scheme might characterize group decision making under high task uncertainty. Kerr (1983) and Laughlin and Ellis (1986) speculate that such a decision process might arise when group members have very little commitment to or investment in their preferences, when maintaining group harmony is vital, or both. In support of the latter conjectures, Kerr (1992) found that as the importance of the issue being discussed by group members declined, so did factions' apparent strength in numbers.

Asymmetric D

Laughlin (1980; Laughlin & Ellis, 1986) has also suggested that for many tasks there is a widely shared consensus on the criteria for the evaluating group decisions. Simple mathematics problems nicely illustrate such intellective tasks; basic mathematical rules provide an objective basis for arguing that one solution is better than another. When certain conditions are met, Laughlin and Ellis (1986) suggest that particular alternatives are demonstrably correct. These conditions are (a) a conceptual evaluative system is shared among group members; (b) there is sufficient information available to the group to discover the "correct" response; (c) group members are able to recognize such a correct solution when it is presented in the group; and (d) any group member or members who favor the "correct" response have the ability, motivation, and time to demonstrate its correctness. The first of these criteria underscores an important point to which we will return. It is certainly possible to judge correctness within an abstract, formal logic with a few axioms, such as judging that a particular proof of a mathematical theorem is correct. However, when it becomes a matter of asserting and defending the correctness of one's judgment to others, "correctness" is largely a social construction. There must be some kind of reasonably clear and widely shared social consensus about what is and is not "correct" (and why) in order for one to convince others that one's preferred judgment is indeed the "correct" one. Moreover, the shared conceptual evaluative system underlying such judgments need not correspond to any particular normative (i.e., logically or empirically correct) system. For example, among Galileo's inquisitors, the assumption that everything in the universe revolved around the earth was clearly "correct," despite the clear empirical evidence he could provide that Jupiter had moons that revolved around it. To avoid confusion between the latter notion of normative correctness and the former, socially defined notion, we will continue to add quotes whenever we mean that an alternative is demonstrably "correct" in Laughlin's sense.

For highly demonstrable tasks, Laughlin has shown (e.g., Laughlin et al., 1976; Laughlin & Ellis, 1986) that all that is required for the group to choose the "correct" alternative is for there to be a single individual who advocates this alternative (a *truth-wins* social decision scheme; see Table 2). When the demonstrability conditions are not as fully met, advocates of the "correct" alternative may require some social support to prevail (a *truth-supported wins* decision scheme; e.g., Laughlin et al., 1975; Laughlin & Earley, 1982).

The distinctive feature of the decision schemes that summarize group judgment at intellective or quasi-intellective tasks is their asymmetry: Factions favoring the "correct" alternative are more likely to prevail than comparable (i.e., equally large) factions favoring an "incorrect" alternative. In order to explore the effects of such asymmetries for the relative bias of groups versus individuals, we constructed a strongly asymmetric decision scheme. The 11-person group version of this D is presented in the far right panel of Table 2 (see Appendix B). As one can see in the table, this decision scheme strongly favors alternative NG, with alternative G prevailing only when the initial support for alternative G is very large. This D characterizes likely group decision-making processes when alternative NG is a highly (although not wholly, as in "truth wins") demonstrably "correct" answer.

Summary

We have identified four generic social decision schemes: proportionality (in which a faction's strength is precisely equal to its relative size), majority-wins (in which large factions' strength is larger than their relative size; i.e., there is strength in numbers), equiprobability (in which large factions' strength is less than their relative size), and asymmetric decisions schemes in which an alternative is demonstrably "correct" within some social context.

The implications of these four generic social decision schemes for the contrast of individual versus group bias can be revealed via *thought experiments* (Davis & Kerr, 1986). Using the SDS model, we can not only compare the effects of different global processes of group judgment or decision making (by comparing and contrasting the generic Ds), but by varying other variables and model parameters (e.g., magnitude of individual bias; group size), we can also explore their effects on the central contrast of interest. Wherever enough information is available for an empirical study cited in Table 1 (e.g., the social decision scheme is estimated directly or can be safely assumed to be similar to one of the generic Ds we consider), we will compare the results of that study to those obtained in our thought experiments.

In carrying out our analysis, two general cases can be distinguished. In the first and simpler case (Case 1), a single, unitary process of group judgment, summarized by a single D matrix, describes all groups. That is, all groups transform initial group member preferences to group judgments utilizing the same basic group decision-making process. Under this case, exposure to potentially biasing information may alter individual preferences (i.e., p), but it does not alter the process by which groups forge a collective judgment out of those member preferences (i.e., D itself). In the second case (Case 2), exposure to potentially biasing information again may (or may not) affect the process of individual judgment (and, hence, p), but does affect the process of group judgment (i.e., D). We separately consider Case 1 and Case 2 below.

Case 1: Unitary Group-Judgment Process

We have now defined three qualitatively different types of bias and identified several (viz., four) different Ds (summary processes for group information processing or decision making) that are empirically or theoretically interesting. Below, using computer-assisted analyses, we examine the consequences for RB, the relative bias between individuals and groups, of each of the possible combinations of D and bias type (see Grofman, 1978, for a similar, but more limited analysis). Our objective is to map RB across the full domain of possible levels of individual bias and to see how RB may depend upon a variety of factors (such as the type of bias, the idealized standard of unbiased judgment, the magnitude of individual bias, group size, and the process of group decision making).[6]

Sins of Imprecision (SofI)

Proportionality D. As noted above, a proportionality social decision scheme simply reproduces the entire distribution of individual judgments in groups, such that $P = p$. Because groups reach precisely the same decisions as individuals under this decision scheme, there should never be any difference in the magnitude of bias (i.e., $RB = 0$, under all possible conditions, all possible group sizes, all possible ideal Is, etc.). However, this degenerate case is still useful as a theoretical baseline (Davis, 1969) and as means of introducing our method of conducting and plotting the results of our thought experiments.

Because we have restricted our attention to dichotomous judgments, the distribution of judgments by individual judges is fully expressed by p_G, the proportion of individuals favoring the first alternative (since $p_{NG} = 1.0 - p_G$). Our base analyses assumed that group size, r, was 11 (an odd number was chosen to obviate a subscheme for the majority D). Then, for every possible individual behavior (i.e., for any p_G value between 0.0 and 1.0), we calculated the expected distribution of group choices, $\hat{P}_G$, under the assumption of a proportionality group decision-making process by using Equations 1–3 and the proportionality D in Table 2. Of course, for the proportionality decision scheme, because $\hat{P}_G$ always is equal to p_G, the plot of $\hat{P}_G$ as a function of p_G is the simple straight line depicted in Figure 2 and RB would always equal 0 (since $RB = B - b = |\hat{P} - I| - |p - I|$). The same would also be true for any other group size.

Simple-majority D. A rather different functional relationship resulted, though, when the simple-majority D in Table 2 was used in a similar computer-assisted analysis (see Figure 2). As Davis (1973) originally showed, the effect of a (symmetric)

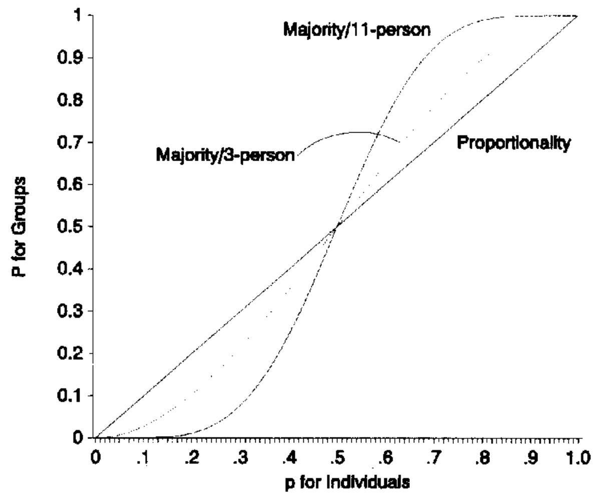

Figure 2. Predicted group judgment, $\hat{P}_G$, as a function of individual judgment, p_G, under proportionality and simple-majority social decision schemes.

group decision-making process that has strength in numbers, which gives large factions disproportional influence, is to make the more popular individual choice even more popular among groups. As Figure 2 shows (also see Davis, 1973; Davis & Kerr, 1986; Kerr & Huang, 1986), if alternative G is preferred by a minority of individuals and if groups follow a simple-majority decision scheme, alternative G is favored by an even smaller proportion of groups. Likewise, if G is preferred by most individuals, an even larger fraction of groups operating under a simple-majority D will endorse alternative G. In short, the popular responses become more popular and the unpopular responses less popular under a majority-wins decision scheme. One implication of this process under most conditions is the group polarization of mean individual preferences (Myers & Lamm, 1976; Kerr, Davis, Atkin, Holt, and Meek, 1975).

This pattern, although perhaps not intuitively obvious, is reflected in familiar experience. A vivid example is the way in which national difference of 6% in individual voters' preference for presidential candidates Bush and Clinton resulted in a 37% difference in popularity in the electoral college; of course, state electors are chosen using a majority-rules (or, more precisely, plurality-rules) decision rule (see Rosenwein & Campbell, 1992). This pattern is easily understood as a direct consequence of a familiar sampling principle: sample statistics are more stable in larger (e.g., group) than smaller (e.g., individual) samples. For example, consider a biased coin that produces "heads" with probability .60 on individual flips. However, suppose that instead of considering individual flips we considered "groups" of 1,000 flips. Now, the probability of getting more heads than tails (i.e., a majority of heads) in such a "group" would be considerably higher than .60 (approximately 1.0, in fact). As sam-

[6] In this article we present the full results of these computer-assisted analyses. Elsewhere (Kerr et al., 1996) we have presented a physical metaphor that can assist one's intuition about the consequences of our theoretical assumptions.

ple size decreases, the sampling error increases and "the proportion of samples getting more heads than tails" statistic declines until it reaches .60 when sample size equals one.

The foregoing clearly suggests that the larger the group is, the stronger the polarizing effect of group decision making. And indeed, when one compares the results of repeating our computer analysis with a smaller-sized group ($r = 3$), one confirms this suggestion (see Figure 2). This turns out to be a very general phenomenon: The effects of the social decision-making process summarized by a particular D matrix are generally more pronounced as the size of the group increases. The implication of this rule for our present discussion is that the magnitude of (any nonzero) RB tends to increase as group size increases (all else being equal), but whether groups or individuals are more susceptible to bias (i.e., the sign of RB) tends not to be affected by variations in group size.

Clearly, because a majority-wins process can produce differences between distributions of individual and group judgment, there is the potential for differences in the relative magnitude of bias exhibited by individuals and such groups (i.e., in RB). However, these effects depend crucially upon the nature of the original individual bias, b, which depends in turn upon what constitutes unbiased judgment (since $b = |\boldsymbol{p} - \boldsymbol{I}|$). To illustrate, we return to our prospect theory example, for which $\boldsymbol{I} = (p_{I,G}, p_{I,NG}) = (.50, .50)$. To simplify, we restrict our attention to the G alternative. That is, rather than calculating and plotting $RB = |B - b| = |\boldsymbol{P} - \boldsymbol{I}| - |\boldsymbol{p} - \boldsymbol{I}|$, we examine the related quantity $RB' = |\hat{P}_G - .5| - |p_G - .5|$. (In the dichotomous-alternative case, it is easy to show that two quantities RB' and RB are strictly proportional to one another (viz., $RB' = RB/\sqrt{2}$); thus, patterns in RB are fully captured by examining RB'.) In Figure 3A we plot the resulting RB' as a function of p_G (here group size = 11, and $\hat{P}_G$ is as predicted by the simple-majority D). As the figure shows, if there is any bias among individuals (i.e., $p_G \neq .5$), under these particular conditions groups would always show a larger bias than individuals (i.e., $RB > 0$; unless $p_G = 0.0$ or 1.0, where floor and ceiling effects prevent groups from being any more biased than individuals).

However, what if the model of unbiased judgment prescribed that alternative NG was the correct, unbiased choice, that is, $\boldsymbol{I} = (p_{I,G}, p_{I,NG}) = (0.0, 1.0)$? For example, in Kahneman and Tversky's (1972) well-known research demonstrating improper use of sample size information, we might force participants to choose between Hospital G (with 45 births per day) and Hospital NG (with 15 births per day) in response to the question posed by Kahneman and Tversky (viz., "Over the course of a year, which of these two hospitals will have more days on which more than 60% of the births were boys?"); because there is greater sampling error with a smaller sample, the normatively correct answer is Hospital NG. As Figure 3B shows, if most individuals get this question correct ($p_G < .50$) and 11-person groups operate under a simple-majority decision scheme, even more groups will make the correct judgment (i.e., $RB' > 0$), but if most individuals are wrong ($p_G > .50$), an even larger fraction of groups will be mistaken (i.e., $RB' < 0$). Given the symmetry in the simple-majority decision rule, precisely the opposite function would result had alternative G been the "correct" response (see Figure 3C).

If the idealized, nonbiased standard of judgment were not one of these standard possibilities (i.e., all for G, all for NG, or indifference between G and NG), the picture can become more complicated. For example, we also plotted the RB' versus p_G function when unbiased behavior requires individuals to favor alternative G 75% of the time, that is $\boldsymbol{I} = (.75, .25)$.[7] As Figure 3D shows, when individuals are relatively highly biased ($p_G < .5$), groups operating under the simple-majority decision scheme tend to exacerbate this bias, as in all the previous cases we have considered. However, if individual performance were less biased (i.e., $p_G > .5$), we see that the result of a majority rule is a complex function, with groups reducing bias in one region ($.5 \leq p_G \leq .67$) and increasing it in another ($p_G > .67$).

The moral of these stories should be clear: As far as sins of imprecision are concerned, a group decision-making process that gives disproportionate weight to numerically large factions (like the simple majority-rules D) does not have a single, simple effect on the relative magnitude of group versus individual bias. Generally, good (i.e., unbiased) individual performance results in even better group performance, whereas poor (biased) individual performance tends to be reflected in even poorer group performance. However, RB will also depend (systematically) upon how ideal–unbiased responding is defined, how biased individuals are, and how large the group is. This conclusion is not simply a theoretical curiosity. Strength-in-numbers group decision-making processes seem to characterize a wide domain of judgmental tasks. Theoretically, this should occur any time the normatively unbiased–ideal (or any other) response is not demonstrably correct (Laughlin & Ellis, 1986); this is a situation that seems likely to characterize many of the complex information processing tasks for which individual judgmental biases have been demonstrated. And, as noted above, various majority-wins Ds have been empirically validated more often and for more tasks than any other general type of social decision scheme.

Equiprobability. The net effect of an equiprobability social decision process (in which there is no strength in (nonunanimous) numbers) is precisely opposite to that produced by the majority process we have just considered (in which there is disproportionate strength in numbers; Davis, 1973). As we have seen, the latter tends to enhance among groups individual preference differences among individuals; the former tends to smoothe out among groups any individual preference differences among groups. This is evident in the plots of $\hat{P}_G$ versus p_G

[7] One has to be a bit creative (and perhaps dogmatic about what would constitute an unbiased judgment) to illustrate this case for a dichotomous judgment. For example, in a probability matching task (Zajonc, Wolosin, Wolosin, & Sherman, 1968) in which Light G is lit 75% of the time and Light NG is lit 25% of the time, one (arguable) definition of unbiased behavior would prescribe that the judge choose G 75% of the time and NG 25% of the time. However, with a multialternative response scale, one can easily identify judgmental tasks where the ideal–unbiased judgment takes on some particular intermediate value (e.g., a posterior-odds judgment prescribed by Bayes's theorem). The important point is that the same complex variation in RB modeled here for the theoretically precise and tractable dichotomous case would also obtain in the multialternative case under a majority-rules D and reasonable distributional assumptions (see Footnote 11; Kerr et al., 1975).

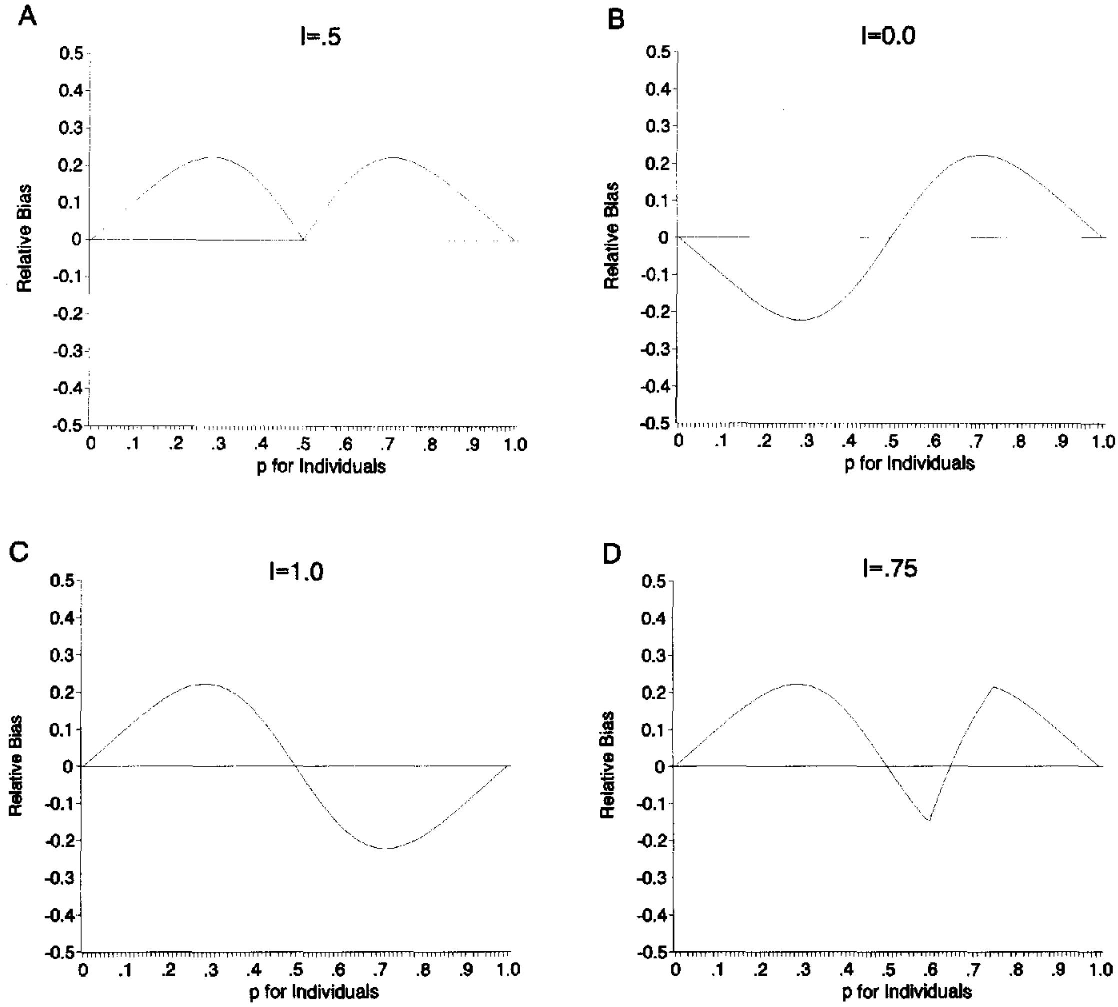

Figure 3. Plots of RB' versus p_G under a simple-majority D when $I = (p_{I,G}, p_{I,NG})$ is (a) (.50, .50), (b) (0, 1.0), (c) (1.0, 0), and (d) (.75, .25). RB' = relative bias; p_G = assumed proportion of individuals preferring G; D = the social decision scheme matrix; I = ideal criterion distribution; $p_{I,G}$ = ideal proportion of individual favoring G; $p_{I,NG}$ = ideal proportion of individuals favoring NG.

for 11- and 3-person groups operating under a strict equiprobability D (see Figure 4A). Relative to the proportionality baseline, these curves are qualitatively mirror images of the corresponding curves for majority rules (i.e., they reverse the qualitative effect of grouping; compare Figure 4A with Figure 2). No matter what individuals tend to prefer, the equiprobability decision process tends to pull groups towards a position of uniform preference across alternatives; here, towards (.5, .5). Once again, the larger the groups, the stronger this tendency.

Given the essential symmetry of the effects of majority and equiprobability decision schemes (around the impactless proportionality baseline), it should not be surprising that the results of the computer analyses deriving RB' under the equiprobability decision scheme produce precisely the opposite patterns to those we just observed for majority rules. So, the general tendency for majority rules to enhance bias in groups is reflected by a corresponding tendency for equiprobability to suppress bias in groups; exceptions to the former rule are (inverted) exceptions to the latter (compare Figure 3A with 4B and 3D with 4C).

It is not the widespread applicability of the equiprobability process that makes these results interesting. Indeed, as noted previously, this particular group decision-making process has only been empirically confirmed for a few rather unusual judgment tasks. What these analyses do demonstrate, though, is that even if many other important features of the judgment setting were held constant (such as judgment task, ideal–unbiased criterion, group size), one can reach exactly the opposite conclusions about the relative degree of bias of groups and individuals under different group decision-making processes. So, for example, if group members tenaciously defend their initial preferences and finally wear down opposing minority views (one type of social process consistent with majority wins), the prospect theory sin of imprecision we have used as a running example

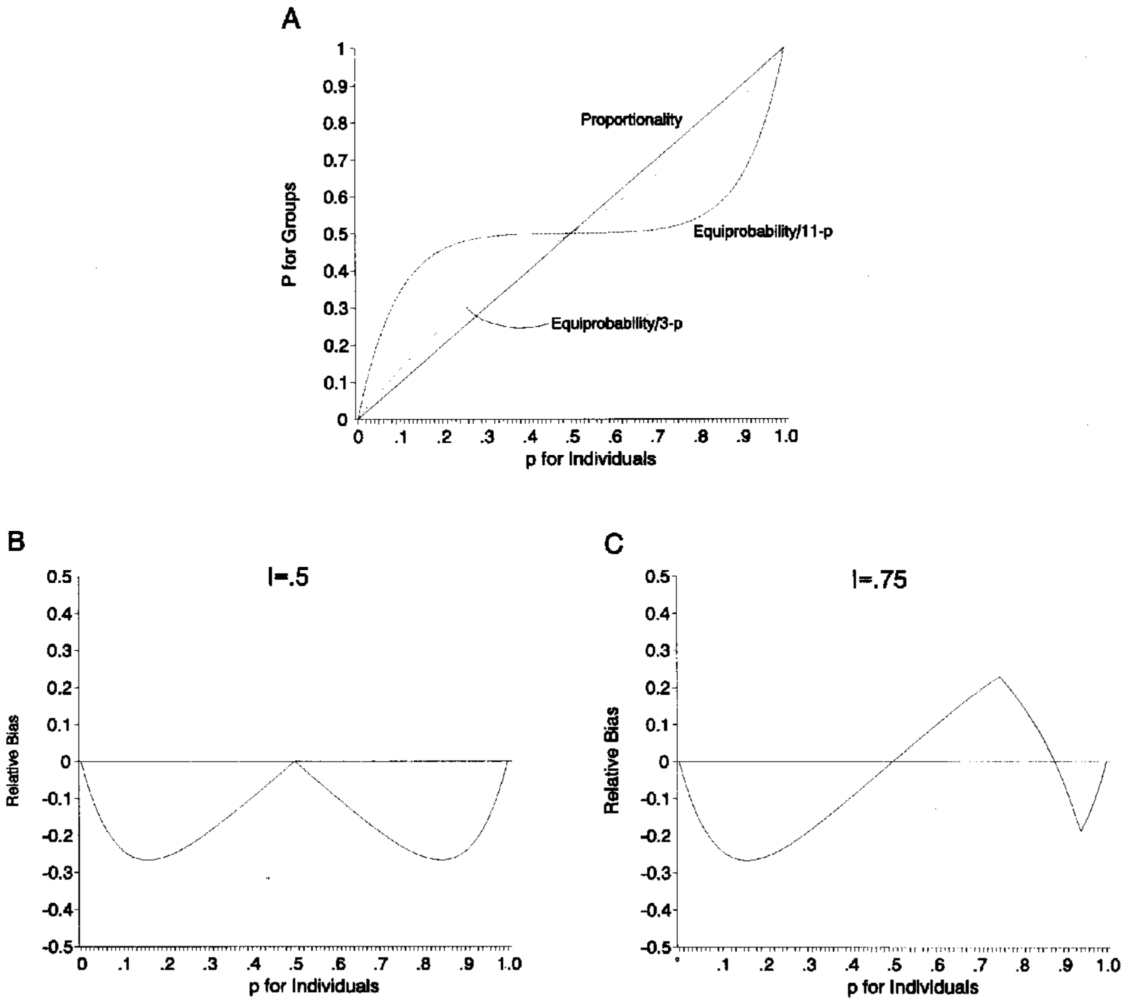

Figure 4. Plots of (a) $\hat{P}_G$ versus p_G, and RB' versus p_G when $I = (p_{I,G}, p_{I,NG})$ is (b) (.50, .50) and (c) (.75, .25) under an equiprobability D. $\hat{P}_G$ = predicted group judgment; p_G = assumed proportion of individual favoring G; RB' = relative bias; I = ideal criterion distribution; $p_{I,G}$ = ideal proportion of individuals favoring G; $p_{I,NG}$ = ideal proportion of individuals favoring NG; D = the social decision scheme matrix; 11-p = 11-person; 3-p = 3-person.

would generally be stronger among groups than individuals (Figure 3A). But if group members were (for whatever reason) uncommonly eager to accommodate opposing viewpoints, even to the point of entirely disregarding which viewpoints had many and which had few advocates (consistent with the equiprobability scheme), then groups should show a weaker bias than individuals (Figure 4B). The clear and crucial point is that *no conclusion about the relative bias of individuals and groups can be reached without careful specification of the operative group decision-making process.*

Strongly asymmetric D. Suppose in our running prospect-theory example that alternative G is the certain-loss alternative and alternative NG is the uncertain-loss alternative (with equal expected value). An expected-utility model would suggest that the ideal, unbiased, and correct choice would be indifference between these two alternatives. Further suppose that the uncertain NG alternative was highly (although not completely) "demonstrably correct" in the sense that Laughlin (e.g., Laughlin & Ellis, 1986) has used the term. This means that it would take very few risk-seeking group members to insure that the group as a whole would opt for the risk-seeking response (i.e., NG); this would be the effect of the group decision-making process embodied in the strongly asymmetric D matrix presented in Table 2.

It is very important to stress again that Laughlin's (e.g., Laughlin & Ellis, 1986) shared conceptual system for evaluation of alternatives that is the basis for the latter type of "correctness" can be but need not be the same as the normative model of judgment that underlies the psychologist's or experimenter's identification of the ideal–unbiased–correct choice (expected-utility theory, in the present case). These can be two wholly separate conceptual systems. The important features of the conceptual system of concern to Laughlin, which we might term the *functional model of judgment,* is that it is widely shared and accepted in the population of judges, and that it is appealed to by and will be persuasive to members of that population.[8] This may or may not be the same conceptual system shared, accepted, and revered by logicians, statisticians, game theorists, etc. (i.e., the normative model). To illustrate:

1. Although it would clearly be incorrect in the normative model that is English common law for a juror or a judge to treat a defendant's religion as evidence of guilt, such a bias might have been demonstrably "correct" in a courtroom in Nazi Germany.

2. It is hard to think of a logical reason for characterizing one of the following football options as normatively correct: Should we kick for the extra point and settle for a tie (choice G) or go for the risky two-point conversion to try and win the game (choice NG)? But, Laughlin and Earley (1982) provide evidence that within a widely shared, conceptual belief system (in which the essential—only?—point of competitive sports is to win), the go-for-the-win alternative is "demonstrably correct."

3. Shafir, Simonson, and Tversky (1993) recently argued that "the axioms of rational choice act as compelling arguments, or reasons, for making a particular decision *when their applicability has been detected,* not as universal laws that constrain people's choices" (p. 34; emphasis added). This suggests that in those studies where groups fail to show closer adherence to the rational-choice normative model (e.g., McGuire et al., 1987; Mowen & Gentry, 1980), these axioms either fail to be voiced, do not appear applicable, or do not appear compelling (i.e., are not the axioms of people's functional model).

Our first computer-assisted analysis using the strongly asymmetric decision scheme revealed that this D's net effect is qualitatively much like a majority-rules decision scheme, but with a quantitative exception. If you feel comfortable with the graphical results of the analyses, examine Figure 5A (and compare with Figure 2) and note that the inflection point of the function relating group to individual behavior (i.e., the function of $\hat{P}_G$ as a function of p_G) is displaced to the right (see Figure 5A), toward the pole that is incorrect under the functional model. If you prefer to think in metaphorical terms, the strong asymmetry basically acts like a strong pull toward the favored (here, NG) option, a pull that cannot be resisted in the group unless nearly all group members initially prefer the "incorrect" alternative (in the present instance, unless p_G begins to approach 1.0; see Kerr et al., 1996, for a further development of this metaphor).

The net results on RB' of introducing such an asymmetry likewise produces a similar distortion of the corresponding majority-wins function (e.g., compare Figure 5B with Figure 3D). The most interesting patterns emerge for the cases where the normative and functional conceptual systems are mutually reinforcing (or identical) versus mutually opposed to one another. Illustrating the former case, suppose the ideal–unbiased response is to choose the NG alternative, that is, $I = (p_{I,G}, p_{I,NG}) = (0.0, 1.0)$. The extremely strong pull toward the NG alternative exerted by the strongly asymmetric D insures that groups are practically always closer to the ideal than individuals (i.e., $RB' < 0$; see Figure 5C); the rare exception occurs when practically no individuals favor the demonstrably correct alternative (see the tiny region where $RB > 0$ when $p_G \approx 1.0$, Figure 5C). This strongly suggests that when the judges subscribe to the same (or a functionally identical) logic as the experimenter, that is, when the participants' and the experimenter's conceptual systems coincide, groups should usually be much less biased (relative to the experimenter's criterion) than individuals.

On the other hand, a functional model's strong pull would insure that groups would practically always be farther from the ideal if it were the normatively defined *in*correct response that was, under that functional model, demonstrably correct, that is, if $I = (p_{I,G}, p_{I,NG}) = (1.0, 0.0)$. (See Figure 5D.) Again, the only time the group could manage to overcome this pull would be when there is practically no one who favors the "demonstrably correct" alternative. When the judges' personal logic is functionally opposite to the experimenter's, groups should usually be much more biased (relative to the experimenter's criterion) than individuals.

One study cited in Table 1 provides a nice empirical illustration of the latter possibility. Tindale, Sheffey, and Filkins (1990) identified the number of persons in each of their 4-person groups who did not and did exhibit a conjunction error in an individual pretest and then determined whether the group itself committed such an error. In essence, this permitted Tindale et al. to estimate the operative D matrix to link individual performance, $\boldsymbol{p} = (p_{correct}, p_{error})$, to group performance, $\boldsymbol{P} = (P_{correct}, P_{error})$. This D matrix estimate is reproduced in Table 3. It is clear that there is a strong asymmetry in the matrix, which indicates that the normatively incorrect alternative (committing a conjunction error) exercises a strong functional pull in the groups. As we have just shown, when a functional model operates in opposition to the normative model, group discussion should typically exacerbate individual bias. And this was precisely the result Tindale et al. obtained.

Summary. When bias is defined as a sin of imprecision, RB has been shown to depend on a number of factors: what behavior is identified as ideal, on the degree of bias among individuals, (quantitatively) on the size of the group, and on the process whereby group judgments are reached. Examining the four generic social decision schemes, few generalizations about relative bias have been shown that hold across all (or even most) levels of the remaining factors. In fact, about the only such generalizations to emerge from our analyses arose when there was a strong asymmetry in the group decision process. When the asymmetry favors the choice prescribed by the normative model (i.e., the normative and functional models coincide), bias is nearly always lower among groups than individuals. However, when the asymmetry favors the other, normatively proscribed choice, bias is nearly always higher among groups than individuals. It has also been shown that (a) all other things being equal, processes that exhibit more-than-proportionate strength in numbers (e.g., majority wins) and those exhibiting less-than-proportionate strength in numbers (e.g., equiprobability) tend to lead to precisely opposite conclusions about relative bias; and (b) the direction of the difference in bias between individuals and groups is generally unaffected by group size, but this difference tends to get larger as group size increases.

[8] Actually, there need not be just a single, unitary functional model. It is quite possible that there could be more than one such functional model. Their combined effects would be summarized by a D that would most likely be asymmetric. It is the nonexistence of any such functional model or models that is indicative of purely judgmental tasks, typically summarized by a symmetric D with high strength in numbers.

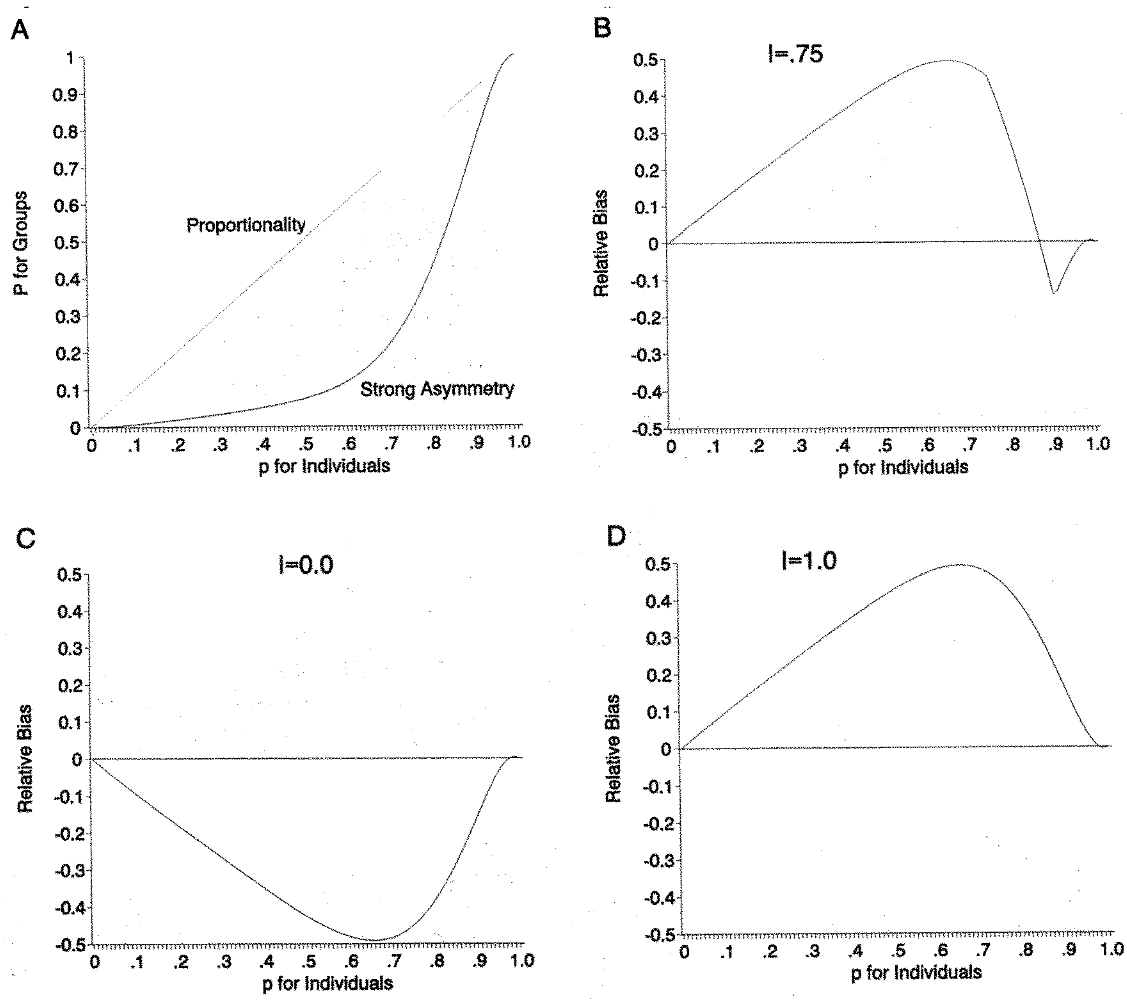

Figure 5. Plots of (a) $\hat{P}_G$ versus p_G, and RB' versus p_G when $I = (p_{I,G}, p_{I,NG})$ is (b) (.75, .25), (c) (0.0, 1.0), and (d) (1.0, 0.0) under the strongly asymmetric D. $\hat{P}_G$ = predicted group judgment; p_G = assumed proportion of individuals preferring G; RB' = relative bias; I = ideal criterion distribution; $p_{I,G}$ = ideal proportion of individuals favoring G; $p_{I,NG}$ = ideal proportion of individuals favoring NG; D = the social decision scheme matrix.

Sins of Commission (SofC)

As our review of the literature suggested, empirical comparisons of individuals and groups for judgmental sins of imprecision are not commonplace. This probably reflects the fact that unambiguously demonstrating such a bias is very difficult. To do so requires (a) a normative model sufficient to make a point prediction (e.g., Meehl, 1990); (b) an experimental paradigm that effectively controls all other sources of systematic judgmental error; and (c) a response scale that meets what may be severe psychometric requirements (e.g., interval or even-ratio level of measurement). Empirical demonstrations of sins of commission (and their converse, sins of omission) are far easier, and hence, more commonplace. The normative model need only make an ordinal prediction, other sources of systematic error can (with care) be equated in the high and low bias conditions, and valid conclusions may still be drawn without crawling out on shaky psychometric limbs. For these reasons, the exploration of the effect of individual bias, group size, etc., on RB in the SofC (and SofO) cases is more relevant to understanding existing (and potential) contrasts of individual and group judgment than the preceding analysis of the SofI case. However, the SofI analyses do provide a foundation for understanding these more typically studied judgmental biases.

Proportionality D. Once again, the proportionality decision scheme is most useful as a baseline (against which to compare the other Ds) and as a way of introducing our method of presentation for the computer-assisted analyses. In the judgmental sin of commission, judges use proscribed information. Because this type of bias involves comparing two groups of judges (which differ with respect to the availability or level of biasing information), there are now two "degrees of freedom" in the domain of possible individual bias effects: the popularity of the G alternative in the high-bias condition ($p_{H,G}$) and the corre-

Table 3
Estimated D Matrix From Tindale, Sheffey, and Filkins (1990; as Cited in Tindale, 1993)

Prediscussion splits			Proportion of groups avoiding and committing the conjunction error	
Correct	Error	N^a	Correct	Error
4	0	16	.63	.37
3	1	65	.42	.58
2	2	166	.31	.69
1	3	189	.27	.73
0	4	131	.10	.90

Note. [a] Number of instances in which groups began discussion with this prediscussion split.

sponding value within the low-bias condition ($p_{L,G}$). Without any loss of generality (and in conformity to our labels), we assume that bias at the individual level means not just that $p_{H,G} \neq p_{L,G}$, but more specifically, that $p_{H,G} > p_{L,G}$. For example, suppose we are interested in whether exposure to incriminating pretrial publicity biases jurors (Carroll et al., 1986). The normative model of unbiased–ideal judgment would assert that after usual legal precautions have been taken (e.g., careful juror selection, judicial instructions to disregard information obtained outside of the courtroom), there should be no difference in conviction rate between those exposed to incriminating publicity—high- (potential) bias condition—and those exposed to no or nonincriminating publicity—low-bias condition, that is, $p_{H,G} = p_{L,G}$—whereas an elevated conviction rate in the former condition (i.e., $p_{H,G} > p_{L,G}$) would indicate that such information biased juror judgment. Again, we want to explore what happens to relative bias, *RB*, across the full domain of possible individual degrees of bias: in the SofC case, for all ($p_{H,G}$, $p_{L,G}$) such that $p_{H,G} > p_{L,G}$.

In Figure 6 we plot the individual bias surface, $b = p_{H,G} - p_{L,G}$ (>0 since, by assumption $p_{H,G} > p_{L,G}$). This surface is the baseline from which comparisons of bias in groups, *B*, is calculated (since $RB = B - b$). For any particular, possible behavior in the high- and low-bias individual conditions, that is, for any particular choice of ($p_{H,G}$, $p_{L,G}$), and any particular group decision-making process (assumed here in Case 1 to be a constant *D*), it is possible to predict, using the SDS model, what the corresponding behaviors would be in high- and low-bias groups, that is, $(P_{H,G}, P_{L,G}) = (\pi_H D, \pi_L D)$, where π_H and π_L are calculated from ($p_{H,G}$, $p_{L,G}$) using Equation 2. Thus, under the assumptions of our model, we can predict how biased groups should be for any particular pattern of individual bias.

The results of such calculations for the proportionality *D* are simple. Because this decision scheme simply reproduces precisely among groups what happens among individuals, $B = |P_{H,G} - P_{L,G}| = |p_{H,G} - p_{L,G}| = b$ and $RB = 0$; groups and individuals would necessarily be equally biased.

Simple-majority D. The earlier analysis of SofI suggested that a simple-majority decision process often exacerbated bias in groups, but that for certain ideal–criterion values, the opposite could also occur. A qualitatively similar conclusion emerges from our analyses of the SofC case. The *RB'* surface (with $r = 11$) is plotted in Figure 7A.[9] Of major interest, of course, is the departure of *RB'* values from 0; here, from the horizontal plane at $RB' = 0$ (see Figure 7B), groups are more biased than individuals where the surface is above this plane, and are less biased where the surface dips below this plane. This is a bit hard to see in the three-dimensional (3-D) plot, so in Figures 7C and 7D, we have plotted the intersection of the surface with the no-individual-group-difference plane (i.e., we plot the $RB' = 0$ contour function). In Figure 7C the contour function is displayed with the same orientation as the previous plots. Figure 7D is a two-dimensional (2-D) version of Figure 7C (imagine grasping the plane in Figure 7C by the edges and tilting it up; or imagine looking down on Figure 7C from above). This intersecting curve divides up the domain of possible individual behavior into regions where groups are more biased ($RB' > 0$ and $B > b$) and groups are less biased ($RB' < 0$, $b > B$) than individuals. As Figures 7C or 7D show, for the largest part of the domain of possible individual behaviors, the polarizing majority-rules process results in greater bias in groups.[10] The exceptions arise when all individuals, in both the high- and low-bias conditions, get too close to either pole. The polarizing effect of the majority-wins scheme may be likened to strong, symmetric pulls at both ends of the response scale (cf. Kerr, MacCoun, & Kramer, 1996). When individual preferences get somewhat extreme (i.e., p_G begins to approach either 0 or 1), group preferences get extremely extreme (i.e., P_G gets very close to 0 or 1; see Figure 2). Although hardly as catastrophic, this situation is a bit like wandering too close to a black hole: You get pulled in quickly and flattened at the event horizon (e.g., Hawking, 1988). If the high- and low-bias conditions, separated by a tangible distance, *b*, both get too near either pole, both conditions likewise get pulled (polarized) and their tangible *b* gets flattened to a less tangible *B*.[11]

[9] An identical analysis was run assuming a 3-person group. The resulting surface was precisely the same shape, but simply compressed on the vertical axis; that is, the magnitude of individual group differences were smaller, but qualitatively the same as in the analysis for 11-person groups.

[10] The more balanced the case being considered by the jury (i.e., the closer the overall conviction rate is to .5), the greater the exaggeration of bias in groups relative to individuals (MacCoun, 1990). In this sense, at least, Kalven and Zeisel's (1966) speculation that extralegal bias is "liberated" in groups considering very close cases is nicely confirmed.

[11] The simple, dichotomous-choice situation we have been considering has a hidden but crucial characteristic: The extremity of individual preference (e.g., proportion convicting) is negatively correlated with the skewness of the distribution. The net effect of applying a majority rule is to increase (among groups) the popularity of the modal position and to "pull in the tails" of the distribution (see Davis, 1973). If the distribution of individual preference is skewed, then this tends to move the mean closer to the mode of the distribution. It is very common, particularly for bipolar response dimensions, for individual opinion to "tail off" (i.e., be skewed) in the direction opposite to the generally preferred position. It follows that a majority-rules scheme predicts group polarization in such cases (Kerr et al., 1975), producing the patterns that we have shown in the text. However, under other possible (but less common) distributional assumptions, we would expect neither group polarization nor an exaggeration of bias in groups. For example, if the high- and low-bias distributions of individual opinion were both sym-

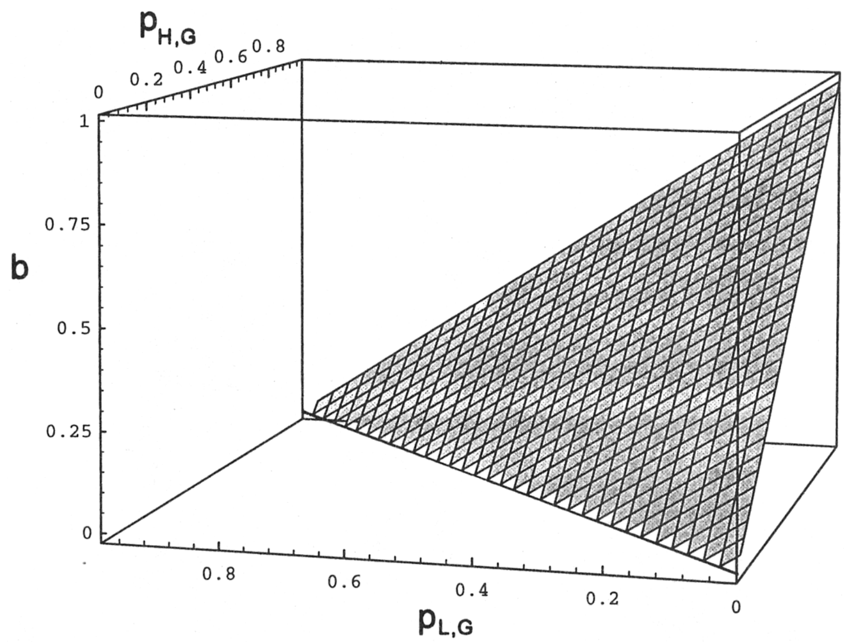

Figure 6. Plot of individual degree of bias, b, for a sin of commission as a function of the probability of individuals favoring the guilty (G) alternative in the high-bias and low-bias conditions (i.e., $p_{H,G}$ and $p_{L,G}$). $p_{H,G}$ = proportion of individuals favoring G in the high-bias condition; $p_{L,G}$ = proportion of individuals favoring G in the low-bias condition.

One thing this analysis teaches us is that whether groups are more or less biased than individuals does not only depend upon how biased individuals are (i.e., on the magnitude of b), but also upon the underlying base rate of behavior. For example, suppose that individual jurors exhibited a bias of 10% due to some extralegal factor (e.g., jurors exposed to prejudicial pretrial publicity show a conviction rate 10% higher than those not so exposed). The current analysis shows that under the majority-wins decision scheme, this effect would be larger in juries if the overall trial evidence were fairly balanced (e.g., the condition means were 45% and 55%), but the same 10% effect among jurors would be attenuated within juries if the trial evidence were lopsided (e.g., the condition means were 5% vs. 15%). Thus, even if different investigators were examining precisely the same bias phenomenon using generally similar research paradigms, one could get completely opposite findings for the degree of relative bias with sufficiently different overall response base rates.

metric, then application of a simple-majority rule will reduce variability in each but will not produce any shift in the means. Similarly, even if both the high- and low-bias distributions were skewed, if they differed only in central tendency (viz., if they were identically skewed), then a majority-rules scheme would produce identical shifts and no net difference in the biasing effect for individuals and groups. And if extremity and skew were positively related (a possible but rather unusual pattern), a majority-wins process would produce depolarization and would generally attenuate bias in groups. So for more complex, multialternative response scales than we focus on in our current analyses, RB will depend on other features (e.g., skewness) besides the mean of the distribution of individual behavior.

One might attribute the "compression" of sins of commission that occur near the poles of the judgment dimension as a type of floor or ceiling effect: The polarizing effect of the majority-wins process should compress effects that begin near the poles of a bounded response scale. But it would be a mistake to dismiss this finding as simply a rare and easily recognized exception to the general rule. This is most strikingly illustrated by the clearest empirical demonstration that juries can attenuate juror bias, Kaplan and Miller (1978). Kaplan and Miller (1978, Study 3) examined the biasing effect of the nonevidentiary behavioral style of various people involved in presenting the case to jurors. In the part of the design of most direct interest to us, Kaplan and Miller contrasted a condition in which the defense attorney in a reenactment of an attempted manslaughter trial acted in a delaying, obnoxious manner versus a second condition in which it was the prosecutor who acted obnoxiously. The legally relevant and material evidence presented to the mock jurors was identical in both conditions. The normative model of judgment would prescribe that the jurors ignore the legally irrelevant factor of advocate's obnoxiousness when making the central judgment of guilt or innocence. However, Kaplan and Miller confirmed a judgmental sin of commission among mock jurors: Prior to jury deliberation the defendant was judged to be guiltier when his attorney acted obnoxiously than when the prosecutor acted obnoxiously. Kaplan and Miller also manipulated the overall strength of evidence against the defendant and, as one would expect, jurors were more likely to convict when the evidence against the defendant was stronger. Jurors then deliberated the case for 10 minutes in 12-person juries and then provided postdeliberation guilt judgments

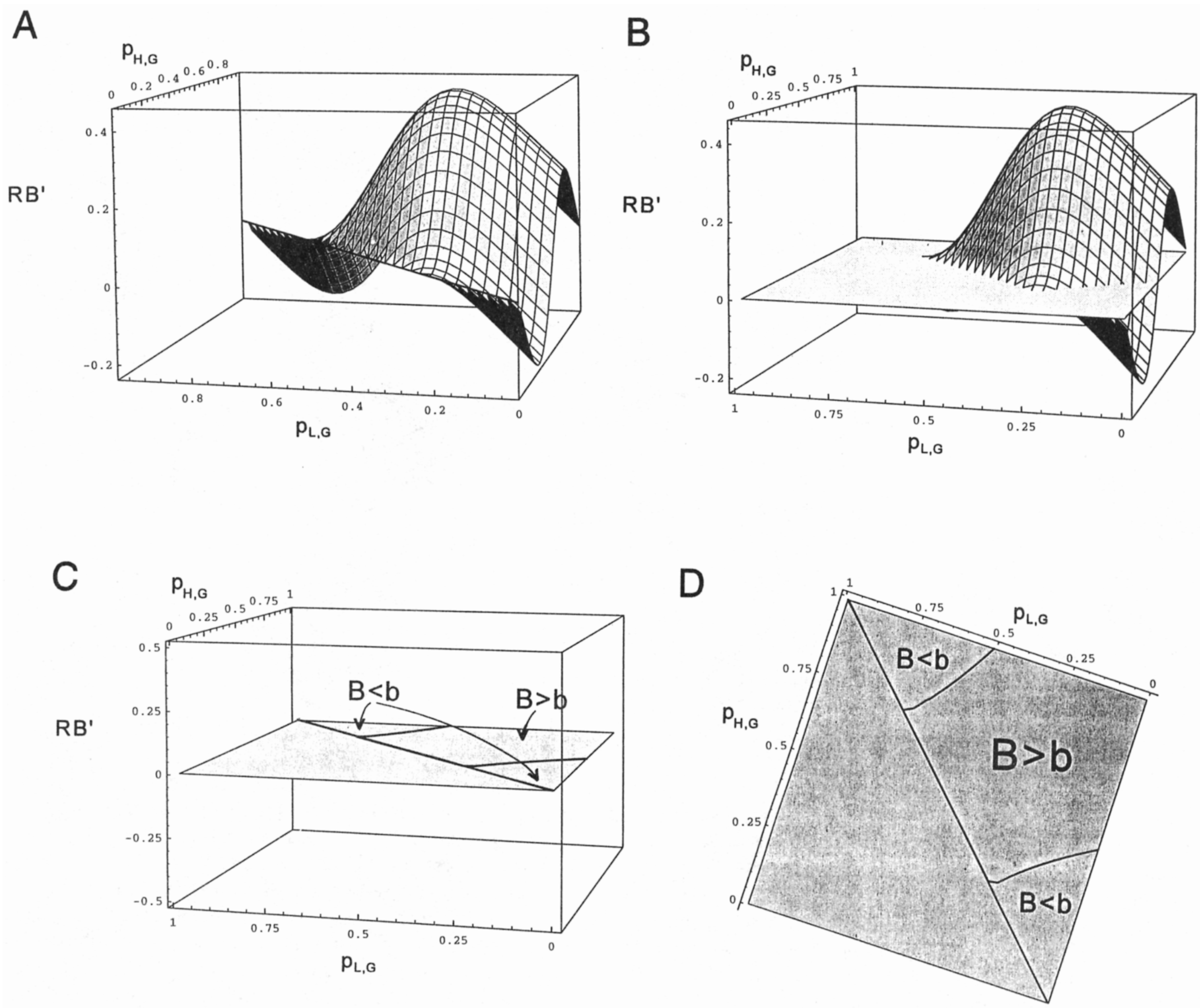

Figure 7. Plots of (a) RB' as a function of $(p_{H,G}, p_{L,G})$ and (b) the $RB' = 0$ contour function under a simple-majority D. RB' = relative bias; $p_{H,G}$ = proportion of individuals favoring G in the high-bias condition; $p_{L,G}$ = ideal proportion of individuals favoring G in the low-bias condition; D = the social decision scheme matrix; B = group bias; b = individual bias.

(which are typically very highly correlated with jury verdict; e.g., Kerr, 1981). The individual (i.e., predeliberation) and group (i.e., postdeliberation) judgments are contrasted in Figure 8. As the figure shows, following deliberation there was a significant polarization effect involving a shift toward greater guiltiness in the high guilt-appearance conditions and toward innocence in the low guilt-appearance conditions. However, there were no significant postdeliberation attorney obnoxiousness biases in postdeliberation judgments; juries were less biased than jurors (in our terminology, $RB < 0$).

Reasoning from information integration theory (e.g., Anderson, 1981), Kaplan has argued (1982; Kaplan and Miller, 1978; Kaplan & Schersching, 1980) that individual jurors' judgments are reached through the integration of many sources of information: personal predispositions (e.g., authoritarianism, general lack of sympathy for criminals, etc.), biasing extralegal factors (e.g., liking for defendant or victim, attitudes toward parties identified with them, like their counsel), and, most important, evidentiary factors. Furthermore, he has argued that jurors recognize, either without reminder or through judicial instructions, that biasing, extralegal material should not actually be considered. This recognition, he has argued, along with the greater amount of information available to the jury results in the content of jury deliberation being dominated by valid, acceptable information (viz., evidentiary material). Since most of the new information to which a juror is exposed during deliberation would not be biasing, deliberating jurors' verdicts should be influenced more by the evidence and less by personal biases during than before deliberation.

This line of argument suggests qualitative differences in the

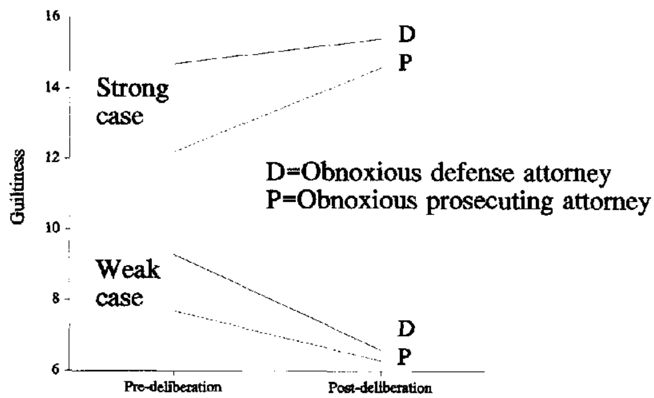

Figure 8. Predeliberation and postdeliberation guilt ratings from Kaplan and Miller (1978, Experiment 3).

process of individual and group judgment. However, our present analysis predicts exactly the pattern of results observed by Kaplan and Miller (1978). We know from much research that juries tend to follow one or another variation on a majority-rules decision scheme (Davis, 1980; Stasser, Kerr, et al., 1989). And our analysis has indicated (see Figure 7) that if all participants (in both the high and low bias conditions) are near a response pole (a result produced in Kaplan and Miller by the strength-of-evidence manipulation), then group judgment should be polarized and the error of commission bias in individuals should be attenuated in groups. Kaplan's theoretical assumption that jury deliberation successfully debiases juror thinking is not necessary.[12]

Another thing we learn from the present theoretical analysis is that whether groups are more or less biased than individuals can depend entirely on the way in which bias is defined (i.e., which type of judgmental sin is being shown). To see this, we return to our prospect-theory example (an instance in which Tversky & Kahneman [e.g., 1981] cleverly devised a paradigm that permitted a sin of imprecision demonstration). We assume further that besides the very general risk-seeking-for-loss bias (which Tversky and Kahneman attribute to nonlinear utility functions), our participants also bring another, more personal bias (e.g., our participant pool is the local chapter of Gamblers Anonymous, whose members are predisposed to take risks). Under these assumptions, individuals would clearly display a risk-seeking bias (i.e., $p_{risky\ alternative} > .5$), and, as we have seen earlier (see Figure 3A), groups operating under a majority-wins decision scheme would show an even larger bias. But suppose instead of comparing our participants' behavior to the unbiased criterion of indifference between alternatives, that is, $I = (.5, .5)$ in a sin of imprecision paradigm, we decide to contrast conditions in which the outcomes are framed as losses versus framed as gains (i.e., in a sin of commission paradigm; cf. McGuire et al., 1987). Under our assumptions, if we randomly assign our gambler participants to loss-frame (high-bias) and gain-frame (low-bias) conditions, we would expect both conditions to generally prefer risky alternatives (i.e., both $p_{H,risky\ alternative}$ and $p_{L,risky\ alternative} > .5$), because of the dispositional bias for risk seeking in this participant population, and, in addition, we would expect to observe the original sin of commission (i.e., $p_{H,risky\ alternative} > p_{L,risky\ alternative}$) that stems ultimately from the nonlinearity of the utility function. Now, assume that groups of our gamblers rather than individual gamblers were to serve as judges and the majority-rules scheme were to summarize those groups' decision making. If the dispositional bias were strong enough (i.e., $p_{H,risky\ alternative}$ and $p_{L,risky\ alternative}$ begin to approach the 1.0), our analysis shows that the original sin of commission effect would be attenuated within groups, exactly opposite to the conclusion that we reached in the SofI paradigm. The important conclusion is that the way in which a particular bias is defined (e.g., SofI vs. SofC) can result in diametrically opposite conclusions about whether groups or individuals are more apt to display that bias, even when we are talking about a single unitary bias phenomenon and the process of group decision making is identical within each type-of-bias paradigm.

Equiprobability D. For completeness sake, we confirmed in the SofC case what had been evident in the SofI case: The net effect of the equiprobability process is to invert the patterns for RB observed under the majority-wins process. Figure 9 presents the relevant results. Under equiprobability, only when all individuals are fairly extreme to begin with do groups magnify individual biases; the general rule (i.e., that $RB < 0$) elsewhere—that is, where at least one of the groups being compared is not extreme—is the opposite of the majority prediction in the same regions.

Strongly asymmetric D. The results of our computer analysis for the strongly asymmetric decision scheme are plotted in Figure 10. Recall that the strongly asymmetric D matrix assumes a functional model for which the second alternative, NG, is (nearly fully) demonstrably "correct." Those with exceptional spatial-reasoning abilities may be able to recognize the resulting RB' surface in Figure 10A as a distortion of the corresponding majority-wins surface (i.e., Figure 7A); those with less than exceptional (e.g., normal) spatial-reasoning abilities might want to forego the exercise of mentally manipulating 3-D surfaces and just skip ahead to the next paragraph, where the net result of a strong asymmetry in D is described. The surface for the strongly asymmetrical D is just the majority-wins surface stretched and distorted toward the back left-hand corner of the 3-D plot, that is, toward the (1.0, 1.0) pole. The net result of such a distortion is summarized in Figure 10D and may be meaningfully compared with the corresponding figure for the majority-wins plot (i.e., Figure 7D). Adding a strong asymmetry to the basic majority-wins model enlarges the $B < b$ area near the favored pole (here, where p_G approaches 0) and shifts and compresses the middle $B > b$ region toward the unfavored pole (i.e., toward the $p_G = 1.0$ pole; see Whyte, 1993, for a possible illustration of behavior in the latter region). In the present instance, the asymmetry is so strong that the other majority-rule $B < b$ region—at the top of Figure 7D—becomes vanish-

[12] Kaplan's RB prediction might well obtain if extralegal information were seen by nearly all jurors to be "demonstrably *in*correct." That is, if there were a functional model of juror decision making that both proscribed using such information and met the other requirements for such a functional model (e.g., widely shared, willingly advocated, etc.), and if advocates for conviction were largely to base their positions on such information, then we might expect the extralegal bias to be weaker among groups.

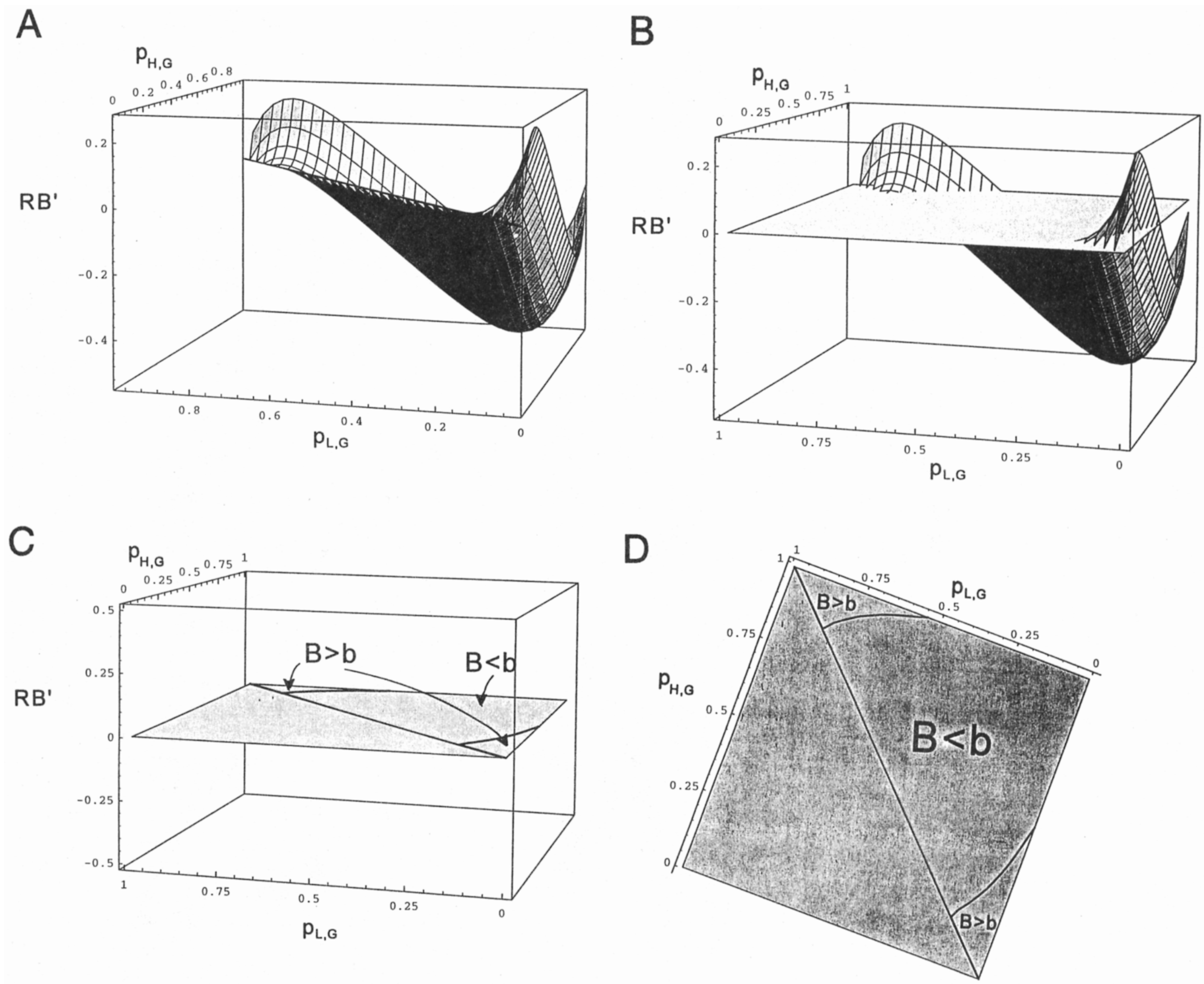

Figure 9. Plots of (a) RB' as a function of $(p_{H,G}, p_{L,G})$ and (b) the $RB' = 0$ contour function under an equiprobability D. RB' = relative bias; $p_{H,G}$ = proportion of individuals favoring G in the high-bias condition; $p_{L,G}$ = proportion of individuals favoring G in the low-bias condition; D = the social decision scheme matrix; B = group bias; b = individual bias.

ingly small. Had the asymmetry been less pronounced, this region could have survived as a small area.

What does this mean? That under Case 1 assumptions, when one direction is strongly favored by a functional model, judgmental sins of commission will more often than not be less pronounced among groups than among individuals. Only when there are very few individual advocates of that favored position to be found should we expect groups to be more biased than individuals (i.e., when mean individual judgment across the high- and low-bias conditions begins to approach the unfavored pole).[13]

The mock jury studies we have identified that examine both predeliberation juror and jury susceptibility to extralegal biases (see Table 1) each examine criminal, rather than civil, cases. Thus, it is important to note one "bias" that typically emerges during criminal jury deliberation—a so-called "leniency bias" (see MacCoun & Kerr, 1988, for a review). There is a reliable asymmetry in criminal jury deliberation that gives factions advocating acquittal better prospects of prevailing in the deliberation than equally sized factions favoring conviction. The net effect of this asymmetry is to make jury verdicts more lenient than juror verdicts (at least for reasonably close cases). MacCoun and Kerr (1988) have presented evidence that this effect is a product of common law norms for protecting the defendant

[13] This relatively simple pattern in the SofC case contrasts with the rather more complicated patterns that arose in the corresponding SofI case (see Figures 5A, 5B, and 5C). Once again, there is the potential for the same basic judgmental bias to produce very different RB values when it is framed as a sin of imprecision versus a sin of commission.

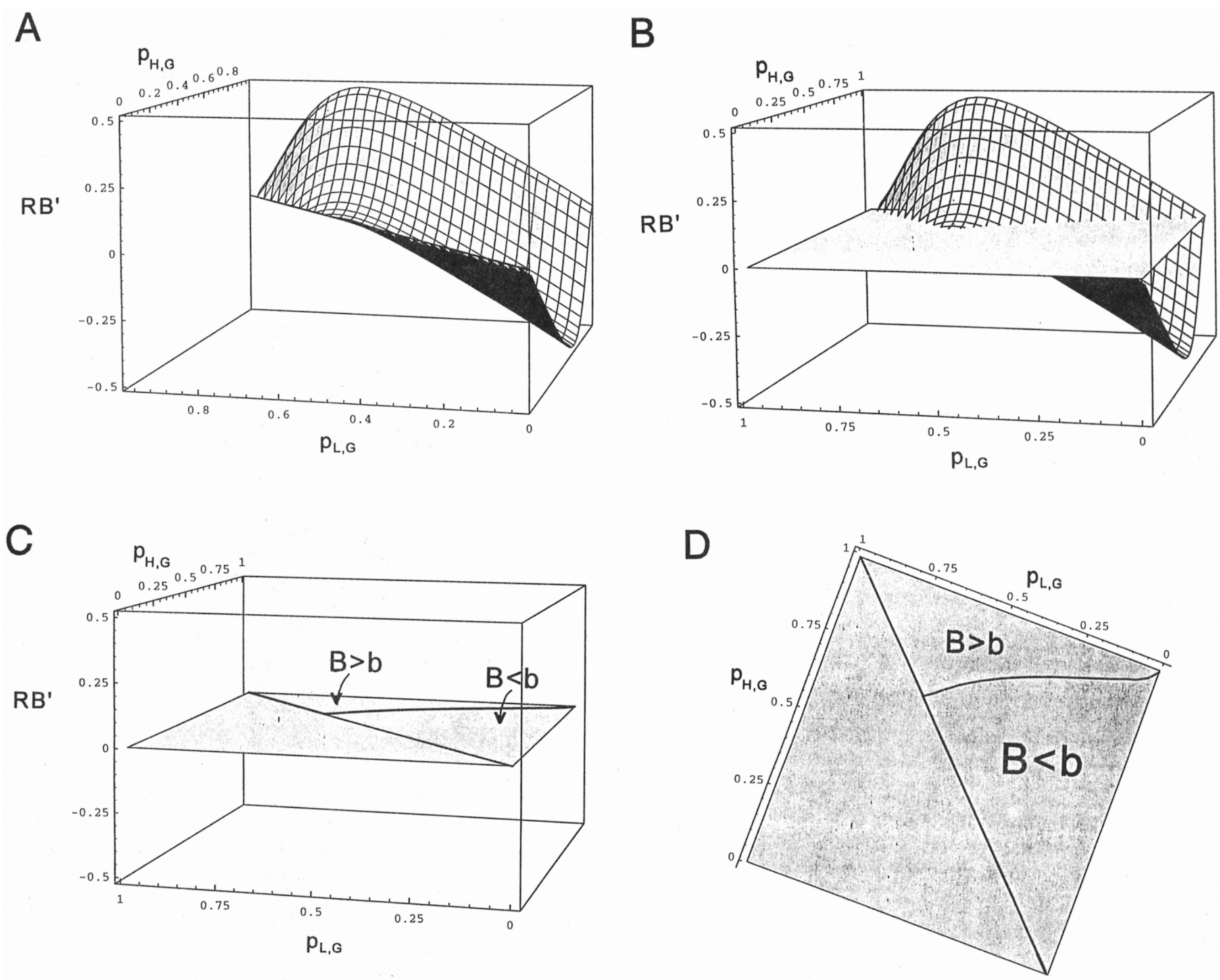

Figure 10. Plots of (a) RB' as a function of $(p_{H,G}, p_{L,G})$ and (b) the $RB' = 0$ contour function under the strongly asymmetric D. RB' = relative bias; $p_{H,G}$ = proportion of individuals favoring G in the high-bias condition; $p_{L,G}$ = proportion of individuals favoring G in the low-bias condition; D = the social decision scheme matrix; B = group bias; b = individual bias.

from false conviction, as reflected in the reasonable-doubt standard of proof and the presumption of innocence requirement. Because such defendant-protection norms (e.g., Davis, 1980) are prescribed by common law, the leniency "bias" is not, with our present definition of the term, really a bias at all. However, when examining the effects of deliberation on genuine extralegal biases, it is important to anticipate that shifts toward acquittal are likely to occur in juries, even in the absence of other biases.

Earlier we showed how juror bias should be attenuated in juries operating under a simple-majority decision scheme only for trials that produced extreme verdict distributions (i.e., p_G near 0.0 and 1.0). But according to the present analysis, a leniency "bias" would expand the former region upward from p_G near 0.0. Thus, if the leniency bias is strong (which appears to depend upon how juries are instructed; MacCoun & Kerr, 1988), we might expect jury deliberation to attenuate bias even if the overall conviction rate is fairly moderate. Interestingly, besides Kaplan and Miller's (1978) study (discussed earlier), the only other study not to observe a clear, unequivocal bias-enhancing effect of jury deliberation is Thompson, Fong, & Rosenhan, (1981). Casting their findings in our present terminology, Thompson et al. found $(p_{H,G}, p_{L,G}) = (p_{\text{pro-prosecution inadmissible evidence},G}, p_{\text{pro-defense inadmissible evidence},G}) = (.53, .38)$ and corresponding jury values of $(P_{H,G}, P_{L,G}) = (.39, .21)$. Statistically, one could not reject the hypothesis of equal degrees of bias by individuals and groups. This pattern of results is consistent with our model if Thompson et al.'s juries had a moderately strong leniency bias, that is, with such a degree of asymmetry, the observed $(p_{H,G}, p_{L,G})$ could lie close to the equal-bias contour curve.

Summary. When a majority-wins decision scheme (or some similar strength-in-numbers decision scheme) is likely to apply (e.g., for clearly judgmental tasks), moving from individual to group decision makers tends to exaggerate individual biases of commission in groups (unless floor–ceiling effects intrude).[14] Again, these patterns are reversed under group decision processes with disproportionately low strength in numbers (e.g., equiprobability). For tasks with demonstrably correct alternatives (e.g., clearly intellective tasks), sins of commission are usually less pronounced in groups (unless the "incorrect" positions are extremely popular, in which case the reverse can be true).

Sins of Omission (SofO)

As far as our central question about relative bias is concerned, this is a simply handled case. A sin of omission means that the high- and low-bias conditions do not differ. If individuals in these two conditions start at the same place (i.e., have the same π vector) and group decision making is summarized by the same process in each condition (Case 1's assumption of a single, constant D in all groups), then the SDS model predicts that groups in these two conditions must likewise end up at the same place. Hence, under Case 1 assumptions, a sin of omission in individuals must result in the same sin of omission in groups. (By identical logic, a sin of omission in groups must, under Case 1 assumptions, imply an identical sin of omission in individuals.) Thus, if there is any difference in individual and group susceptibility to a sin of omission (and, as our earlier overview indicated, there certainly are; e.g., Wright & Wells, 1985; Wright, Lüüs, & Christie, 1990), it can only mean that Case 1 assumptions have been violated. We consider Case 2 next.

Case 2: Varying Group-Judgment Processes

Our assumption in Case 1 of a single social decision-making process for all groups essentially means that for any given initial distribution of member preference (r_G, r_{NG}), the relative ability of each faction to prevail in the coming group discussion is not altered by exposure to potentially biasing information. So, for example, under Case 1 assumptions, receiving prejudicial pretrial publicity may increase a juror's chances of seeing the defendant as guilty, but it would not alter his or her ability, say, to resist a unanimous majority favoring acquittal in a jury beginning deliberation with a $(r_G, r_{NG}) = (11, 1)$ split (relative to a comparable juror in a low-bias condition who had seen no such publicity).

As we have seen, even under the simplifying Case 1 assumption, the relative degree of individual and group bias depends on a number of factors. But it is also quite possible that this assumption is false. Possession of certain information, per se, could actually alter the dynamics of the process of group judgment. In the preceding example, perhaps all other things (and especially the initial distribution of verdict preferences) being equal, a pro-conviction juror could be relatively more persuasive, more resistant to persuasion, or both in the group setting when the jury has been exposed to prejudicial pretrial publicity than when it has not been so exposed.

This is not a possibility in the sin of imprecision case, because there are no high- and low-bias conditions receiving different information for this type of bias. Rather, all individual and all group judges are given the same basic task information and their respective judgments are then compared to a standard defined by a normative model. It is, however, definitely a possibility for the other two types of bias; for both sin of commission and sin of omission it may be that $D_H \neq D_L$. Of course, there are literally an infinite number of ways that this could occur. Later, we speculate on the nature of such process differences, but first it is useful to examine a handful of studies that document that such differences do indeed occur.

Sins of Commission (SofC)

The most direct way to document such effects is to identify differences between the best-fitting or estimated D matrices for high- and low-bias groups. Unfortunately, there have been relatively few studies that have provided the data required to explore this possibility. Furthermore, the amount of data required to provide convincing statistical evidence can be prohibitive.[15] Nevertheless, we have identified three such studies that provide some fragmentary but suggestive evidence.

Two of these studies examine extralegal biases in jury decision making. MacCoun (1990) examined the effect of defendant physical attractiveness on the verdicts of 4-person mock juries. The biasing effect of defendant appearance information was somewhat greater among juries (an effect of 18% on conviction rate) than among individual jurors (an effect of 12%). This pattern is consistent with the predictions of the majority-wins primary scheme revealed in our Case 1 computer analyses.[16] The observed frequencies of initial split to final verdict transitions are presented in Panel A of Table 4; the relative frequencies (by row), provided in parentheses beneath the raw frequencies, represent the entries of the estimated D matrices for the high- and low-attractiveness defendant conditions.

As noted previously, besides the usual majority-rules primary scheme, a fair amount of research has documented an asymmetric subscheme for criminal jury deliberation (see Stasser, Kerr, & Bray, 1982; MacCoun & Kerr, 1988). When there is no strong initial majority, pro-acquittal factions are more likely to prevail than comparable pro-conviction factions. For example, one meta-analysis indicated that, on average, acquittal was

[14] It is noteworthy that the general amplification of bias produced by majority Ds occurs in precisely the same area (viz., nonextreme distributions of individual preference) where it would typically take a larger sample size to detect an effect among groups (see Nagao & Davis, 1980, Table 4). Again, power considerations can complicate the comparison of bias at the individual and group levels (Kenny et al., in press).

[15] For example, comparing D matrices for high- and low-bias 12-person juries requires estimation of at least 54 matrix entries (2 matrices, 13 rows and 2 columns per matrix). Even if one could assume relatively uniform π vectors (which is implausible, because for any given distribution of individual preference, there are many unlikely initial splits), in order to have a minimum of 10 groups per row per matrix, one would need 3,120 participants (2 matrices × 13 rows/matrix × 10 groups/row × 12 persons/group).

[16] Under random composition of juries, the relatively small, 12% effect for attractiveness among jurors resulted in a much larger proportion of juries with an initial majority for acquittal when the defendant was physically attractive (12/25 or 41%) than when he was unattractive (4/30 or 13%).

Table 4
Data on Effects of Extralegal Biasing Information Affecting Jury Leniency Bias

Predeliberation verdict split		Outcome of jury deliberation					
		High-bias condition			Low-bias condition		
G	NG	G	NG	Hung	G	NG	Hung
		MacCoun (1990)					
Panel A		Low-attractive defendant			High-attractive defendant		
4	0	1 (1.00)	0 (.00)	0 (.00)	1 (1.00)	0 (.00)	0 (.00)
3	1	7 (.47)	2 (.13)	6 (.40)	3 (.27)	2 (.18)	6 (.55)
2	2	3 (.30)	3 (.30)	6 (.40)	0 (.00)	4 (1.00)	0 (.00)
1	3	1 (.25)	3 (.75)	0 (0.0)	1 (.12)	5 (.62)	2 (.25)
0	4				0 (.00)	4 (1.00)	0 (.00)
		Kramer et al. (1990)					
Panel B		High-emotional publicity			Low-emotional publicity		
5	1	3 (.60)	0 (.00)	2 (.40)	1 (.00)	0 (.00)	0 (.00)
4	2	9 (.45)	0 (.00)	11 (.55)	3 (.33)	0 (.00)	6 (.67)
3	3	6 (.33)	4 (.22)	8 (.44)	0 (.00)	2 (.18)	9 (.82)
2	4	0 (.00)	5 (.42)	7 (.58)	0 (.00)	9 (.82)	2 (.18)
1	5	0 (.00)	1 (.33)	2 (.67)	0 (.00)	4 (1.00)	0 (.00)

Note. G = guilty; NG = not guilty. Numbers in parentheses are relative frequencies (by row).

about four times as likely as conviction for juries that were evenly split prior to deliberation (MacCoun & Kerr, 1988). Inspection of MacCoun's (1990) data in Table 4 suggests that this asymmetry bias was evident when the defendant was attractive but not when the defendant was unattractive. This is seen most directly in the evenly split juries (2G, 2NG). When the defendant was attractive, all such groups acquitted the defendant; when the defendant was unattractive, only 30% (3 of 10) of the juries acquitted. To a lesser extent, the comparison of pro- and anti-conviction majority juries with initial 3–1 splits reveals the same pattern. When the defendant was attractive, pro-acquittal majorities were more likely to prevail than comparably sized pro-conviction majorities ($.62 - .27 = .35$); the comparable figure in the unattractive defendant condition was somewhat lower ($.75 - .47 = .28$). When one drops hung juries, this trend is even clearer: ($5/6 - 3/5 = .23$) versus ($3/4 - 7/9 = -.03$). Although these differences are small and, given these small samples, not statistically significant, they are intriguing. They suggest that the usual willingness to give the defendant the benefit of the doubt (e.g., when there is no clear consensus in the group) is attenuated when that defendant is physically unattractive.

This suggestion is bolstered by a similar pattern of data in Kramer, Kerr, and Carroll's (1990) study of the biasing effects of pretrial publicity. The relevant estimated social decision schemes are presented in Panel B of Table 4. Kramer et al. examined (among other things) the biasing effects of emotional pretrial publicity.[17] And, just as in MacCoun's (1990) data, there are indications that the usual and legally prescribed pro-defendant leniency bias is attenuated when jurors were exposed to prejudicial emotional pretrial publicity. Consider the third row of the lower half of Table 4. In low-emotion publicity juries, when evenly split juries managed to reach verdicts, they were acquittals (2 acquittals, 0 convictions). However, an unusual trend in the opposite direction occurred in the high-emotion juries (6 convictions, 4 acquittals). Likewise in the fourth row, we see that acquittal was relatively less likely (particularly in comparison to hung juries) given an initial pro-acquittal majority in the high-emotion publicity juries than in the low-emotion juries. The association between initial split and verdict in these rows was marginally ($p < .07$) significant.

A third illustration uses the sin of commission approach to

[17] Again, the primary majority scheme may also contribute to the differences between jurors and juries in sensitivity to emotional publicity (which produced the stronger biasing effect among jurors). For example, pro-conviction initial majorities were quite a bit more likely to occur in high emotional pretrial publicity (PTP) groups (43% of the time) than in low-emotion juries (only 28%).

demonstrate the framing biases predicted by prospect theory. McGuire et al., (1987) found very weak framing effects among individuals but rather robust framing effects among groups. Qualitatively, this is fairly consistent with the predictions of a uniform-majority primary scheme. However, McGuire et al. also obtained direct estimates of the operative Ds in the high- and low-bias conditions (viz., the gain- and loss-frame conditions). These estimates, which are similar in structure to those described above for jury deliberations, are presented in the top panel of Table 5 and suggest that the stronger bias in groups could be attributed, at least in part, to different D matrices for the two framing conditions. The most striking differences can be seen in the middle two rows. Clearly, when the problem was framed as a gain problem, risk-averse factions (i.e., composed of those who initially favored taking the sure gain) usually prevailed (77% of the time), but this was true even when the faction was a minority of one (which prevailed 83% of the time). Exactly the opposite occurred for the loss framing; risk-seeking factions usually prevailed (80% of the time), even when it was a single advocate opposing a majority of two (75% of the time). Again, the sample sizes are small and the effects weak (distributional differences within the middle two rows resulted in $ps < .11$ by Fischer's exact tests).

McGuire et al. (1987) speculated that arguments advocating the attitudes toward risk predicted by prospect theory—namely, for risky choices under a loss frame and for more certain choices under a gain frame—are "demonstrably correct" in Laughlin's sense. That is, prospect theory may here be a potent functional model of collective judgment. This claim was bolstered by contrasting the above results, which were obtained in face-to-face discussion groups, with another condition in which all communication between group members took place via a computer network. The corresponding data for this latter condition are presented in the bottom panel of Table 5. It seems likely that it was more difficult for group members to communicate with one another in the computer-assisted-communication condition. Such difficulty seems likely to undermine group members' ability to advocate and recognize their shared conceptual system (which maintains that a sure gain is better than an uncertain one, and a chance to avoid a loss is preferable to a sure loss) and, thus, the "correctness" of the choices prescribed by that system. And indeed, there is little evidence of difference in the estimated D matrices between the two framing conditions.

Table 5
McGuire et al. (1987) Data on Effects of Framing Information Affecting Group Decision Making

Prediscussion preference distribution		Gain frame		Loss frame	
Risk averse	Risk seeking	Risk averse	Risk seeking	Risk averse	Risk seeking
		Group decision–face-to-face discussion			
3	0	1 (1.00)	0 (.00)	2 (1.00)	0 (.00)
2	1	5 (.71)	2 (.29)	2 (2.5)	6 (.75)
1	2	5 (.83)	1 (.17)	0 (.00)	2 (1.00)
0	3	1 (1.00)	0 (.00)	0 (.00)	3 (1.00)
		Group decision–computer-assisted discussion			
3	0	4 (.80)	1 (.20)	3 (1.00)	0 (.00)
2	1	0 (.00)	4 (1.00)	2 (.40)	3 (.60)
1	2	1 (.25)	3 (.75)	2 (.40)	3 (.60)
0	3	1 (.50)	1 (.50)	0 (.00)	2 (1.00)

Note. Numbers in parentheses indicate relative frequencies.

Sins of Omission (SofO)

To our knowledge, no studies have directly estimated D_H and D_L separately within an experimental demonstration of a sin of omission by groups. There is one study, however, that provides strong indirect evidence that the availability of prescribed information can alter the group decision-making process. Wright et al. (1990) found that individuals failed to use prescribed consensus information (i.e., when deciding whether a particular behavior was attributable to internal, dispositional factors or to external, situational factors, individuals paid no attention to whether many (high-consensus) or few (low-consensus) people acted as the target person did. An unbiased judge should attribute the target's behavior more readily to situational factors in the former, high-consensus case. Wright et al. (1990) found, however, that groups did use such consensus information properly: Group discussion appears to have corrected the sin of omission committed by individual judges. If the individuals tended to use consensus information properly but to do so very weakly and nonsignificantly, then this pattern could be understood to be the simple result of a majority-wins scheme. However, not only did individuals show no effect for consensus information, the nonsignificant trend was opposite to the prescribed direction. This pattern of results is hard to explain under Case 1 assumptions and strongly implies that Case 2 assumptions hold here (i.e., a different group decision-making process occurred in the high- and low-consensus information conditions). Other results by Wright et al. further supported this possibility. They found that not just face-to-face group discussion but reading a transcript of another group's discussion or a set of arguments generated by individuals also produced the prescribed use of consensus information. Working from Vinokur and Burnstein's (1973) persuasive arguments theory, they suggest that consensus information is highly potent ("demonstrably correct" in Laughlin's [Laughlin & Ellis (1986)] terminology) but that relatively few participants possess such information. Group discussion gives the opportunity for this potent information to be shared and, in Wright et al.'s, like many SofC and SofO paradigms, the information provided in the two experimental conditions prescribes opposite judgments. This suggests that groups beginning deliberation with ostensibly comparable initial splits are likely to move in opposite directions in the two experimental conditions (much as occurred in McGuire et al., 1987; see Table 5). In effect, this suggests that different D matrices described groups in these two conditions, and it was this difference in process that was (at least in part) responsible for reducing the SofO bias in groups.

General Discussion and Conclusions

The central question of this paper has been, "Which is more likely to make a biased judgment, individuals or groups?" Our overview of the relatively small and diverse empirical literature suggested that there was no simple empirical answer to this question. Even when we restrict our attention to particular bias phenomena (e.g., framing effects, preference reversals), there was frequently little consistency in the direction (i.e., sign) and magnitude of observed relative bias, RB.

Although there appeared to be no simple and general empirical answer to our question, the present theoretical analysis based on the social decision scheme model has revealed many partial answers, all of which begin with "Well, it depends . . . . " Even under the simplifying assumption that the same basic group process characterizes all groups (Case 1 assumption), we have shown that (and how) it depends jointly upon several factors. In particular, it depends on:

1. The size of the group: Generally, as group size increases, the sign of RB is unaffected, but its magnitude increases. (It can also be shown that the latter relationship between group size and RB is a monotonic, negatively accelerating one; cf. Latané, 1981).
2. The magnitude of individual bias: All other things being equal (and most particularly, under any one of several possible group processes), both the direction and magnitude of RB can vary as one varies only the magnitude of individual bias.
3. The location of the bias: All other things being equal, both the direction and magnitude of RB can change with the location in the response domain (e.g., the locations of $p_{H,G}$ and $p_{L,G}$ for sins of commission) of an individual bias of constant magnitude.
4. The definition of the bias: All other things being equal, one can come to diametrically opposite conclusions about RB depending on how bias has been defined (e.g., as a sin of imprecision vs. a sin of commission).
5. The normative ideal: As the ideal judgment shifts, RB can (for sins of imprecision) change both sign and magnitude, even if individual preference and group process remain constant.
6. The nature of the group process: Most important, all other things being equal, different group processes can produce dramatically different RBs. If the particular judgment task determined group process completely (and, as much research has shown, task features such as how judgmental–intellective the task is appear to have profound impact on the nature of the group decision-making process), then this factor at least would not contribute to variance in RB for any particular bias phenomenon. But since such situational, group, or personal factors as the importance of the task, the importance of intragroup harmony, or the judge's general level of uncertainty may also influence the nature of the group process, it is not safe to presume that group process is fixed by task demands.

Also note that all of these complex (but tractable) patterns assume that in any given group and task context, group process (as summarized by D) is constant. When we relax this assumption, many other patterns are possible. Given the extreme diversity of bias phenomena, group sizes, ways of operationalizing bias, experimental contexts, etc., in the empirical literature at a global level, it is, in retrospect, hardly surprising that this literature does not show a simple, consistent pattern of relative bias.

Of course, we ask more of a theory than that it correctly predicts that nature can be complex. A good theory ought to help reduce that complexity: by resolving apparent empirical anomalies, by posing informative new questions, by directing practical application, and by guiding where to look and what to look for. We conclude by discussing how well the present theoretical model satisfies these criteria.

Organizing Past Findings

The biggest stumbling block to applying our analysis retrospectively is in knowing exactly what kind of group processes to assume. In most of the bias phenomena that have been studied, there has been relatively little research using groups as judges, and almost none of this work has tested or estimated (Kerr, Stasser, & Davis, 1979) D-matrix summaries of group-decision process. The one clear exception is research examining jurors and juries committing judgmental sins of commission. Considerable research (see Davis, 1980; Kalven & Zeisel, 1966; MacCoun & Kerr, 1988; Stasser et al., 1982) has established that criminal juries' deliberations are summarized by a high-order majority primary decision scheme (e.g., initial two-thirds majorities nearly always prevail) with a subscheme (applying when there is no strong initial majority) that asymmetrically favors acquittal. From the preceding theoretical analysis, it follows that jury deliberation ought to amplify juror sins of commission unless the conviction rate for jurors is very extreme (i.e., $p_{H,G}$ and $p_{L,G}$ approach 0 or 1.0), although less extremity (i.e., $p_{H,G}$ and $p_{L,G}$ near or just below .50) could still result in attenuation of bias due to the leniency "bias." The relevant empirical literature (see Table 1) is basically consistent with this postdiction; generally, juries appear to be more sensitive to proscribed information than jurors, and the few exceptions to this rule appear to occur where the theory anticipates them (e.g., Kaplan and Miller, 1978, used cases with extreme conviction rates).

Our theoretical analysis can also be applied to organizing findings on topics other than the comparison of biased judgment in individuals and groups. For example, our analyses may have implications for the ongoing debate (e.g., Camerer, 1992; Hogarth & Reder, 1987; Thaler, 1991) about the descriptive validity of the rational-choice model, which plays such a central role in modern economics, political science, and public policy analysis. Many economists have disputed the significance of empirical violations of rational-choice assumptions, offering a number of reasons why laboratory demonstrations might underestimate human rationality in real-life settings. One such argument has been that collective decision making should cancel out judgmental errors. Though this may be correct for aggregate public opinion (Page & Shapiro, 1992), it is premised on a statistical analogy—the law of large numbers—that is clearly incompatible with actual interactive group decision making under some likely social decision schemes (e.g., simple majority wins, truth wins, truth-supported wins). More important, this argument does not apply to judgmental biases—the topic of this article—which are systematic rather than random. At best, our analyses offer an existence proof that collective rationality can sometimes be superior to individual rationality, but they also suggest that over a large and plausible region of relevant parameter space, group decision making actually exacerbates the biases observed in individual decisions.

Posing New Questions

Of course, successful prediction is generally more satisfying than apparently successful postdiction. The preceding theoretical analysis suggests many new and testable hypotheses that ought to be systematically tested (e.g., that the effect of jury deliberation on an extralegal sin-of-commission bias will depend on the overall strength of evidence against a defendant). Moreover, when a particular D can be estimated or confidently assumed, this approach does not make only ordinal predictions that one condition will be more biased than another, but makes specific point predictions over an entire domain of model parameters.

Our original question was essentially posed in terms of the outcome of individual versus group judgment. But our analysis (like so many other previous theoretical analyses of group phenomena; e.g., Zajonc, 1965; Myers & Lamm, 1976; Burnstein & Vinokur, 1977) refocuses our attention away from outcome and toward process. That is, away from the question, "which is more biased, individual or group judgment?" and toward the question, "what are the processes whereby individual preferences are translated into group preferences?" And a social decision scheme perspective on the latter broad question raises several other fundamental questions:

1. "What factors determine the operative social decision scheme, D?" A number of such factors have been identified (including the judgmental–intellective nature of the task, task uncertainty, task importance), but undoubtedly many more remain to be identified. One promising way of identifying such factors may be to examine variables (like those in Appendix A) that are known and can be shown to affect group information processing.
2. "When and why will the availability of certain information alter D; that is, when and why must we abandon the simplifying Case 1 assumptions of a single social decision scheme describing all groups?" Ultimately, this raises fundamental questions of how individuals pool and use information in groups. Once again, processes like those listed in Appendix A seem like good starting points for research. For example, groups seem to have difficulty accessing information that is not widely shared among members. This suggests that we need to be concerned not only with the mean impact of biasing information on individual preference, but on how that biasing information is distributed among group members. It is conceivable for a bit of biasing information to have a clear effect on mean individual judgment, yet, because it is not widely shared among group members, to have little effect in the group. Such a pattern could be manifest by the process of group decision making (i.e., as summarized by the d_{ij}) being different for those with versus without such information (i.e., by the need to make Case 2 assumptions).
3. "What do patterns in the operative decision scheme tell us about the existence and nature of a functional model of group judgment?" We suspect that clear asymmetries in D are especially interesting and informative in this regard. Such asymmetries usually suggest that there is some kind of functional model operating: what Laughlin (e.g., Laughlin & Ellis, 1986) termed a "shared conceptual system" and Tindale (e.g., 1993) termed a "shared representation."
4. "What does the process of individual judgment imply about the functional model of group judgment (and vice versa)?"
5. "When a particular normative model is defensible and groups' functional model departs substantially from that normative model, how can groups be induced to modify their functional model toward the normative model?"

At present we have only fragmentary answers to these fundamental questions.

As noted earlier, our present analysis has been focused on biased judgment, but there is nothing in that analysis to preclude applying it to exploring the relative degree to which individuals versus groups use any information, proscribed or not. If one can determine whether individuals use certain information and one can estimate the relevant D matrix or matrices, then one can show whether groups or individuals are more likely to make use of a piece of diagnostic information. So, for example, Davis et al. (1974) found that in choosing between bets, groups were even more sensitive to relevant bet parameters than were individuals, a result that followed directly from the additional finding that these groups operated under a majority social decision scheme.

Directing Practical Application

Although we have argued that groups will amplify bias under some conditions but attenuate it under others, readers will note that we predict enhanced bias within a region of the parameter space that is likely to characterize many real-world group decision tasks; specifically, sins of commission by groups operating under majority-rule decision schemes (as long as individual judgment is not too extreme). Again, these decision schemes tend to apply to judgment tasks with no clearly shared conceptual scheme for defining right or wrong answers (Laughlin & Ellis, 1986; McGrath, 1984; Stasser, Kerr, et al., 1989); prominent examples include jury decision making, hiring decisions, risky investment decisions, and foreign policy decisions of the type examined by Janis (1982).

Thus, our analyses might be taken to imply that group decision making is ill-advised for this large and important class of real-world decision tasks. But quite apart from many other reasons for preferring group to individual decision makers,[18] our analysis also suggests a strategy for mitigating the bias-amplifying tendencies of groups at such tasks. Ultimately, bias as we have conceived it reflects decisions about whether and how to

[18] For example, compared to individuals, groups tend to attenuate unsystematic, random errors (see Page & Shapiro, 1992; Zajonc, 1962), to better satisfy ideals of procedural fairness and legitimacy (e.g., MacCoun & Tyler, 1988), and to enhance the chances of collective mobilization (Rosenwein & Campbell, 1992). Furthermore, a number of explicit procedures have been recommended for encouraging thorough information gathering and consideration and for promoting unbiased judgment in groups (e.g., Janis, 1982; Stasser & Stewart, 1992).

use information. Group discussion can modify such decisions made by individual members. Presumably, in the absence of a compelling functional model of judgment identifying one particular alternative as "correct," these decisions too are made under a majority–strength-in-numbers decision scheme. This suggests that if the majority of individuals recognize and accept the normative use of particular information, that groups are more likely to choose to use that information properly. This reasoning underscores the value of teaching principles of rational, normative judgment through general education and special training (e.g., Arkes, 1991; Nisbett, 1993; Shafir et al., 1993)—of making defensible normative models into operative functional models for most (but not necessarily all) individuals.

Guiding Where to Look and What to Look for

The SDS analysis advanced here offers a conceptual framework within which to identify and analyze individual–group differences in the use of normatively significant information. But, in addition, it provides very useful methodological tools, the foremost of which is using one or more D matrices to summarize the process of group information processing. Several methods for estimating or competitively testing potential D matrices have been developed (see Kerr et al., 1979). Using such methods, it is possible empirically to determine whether one can or cannot safely make Case 1 assumptions, to detect asymmetries that are the signatures of interesting functional models, and to make not just qualitative but quantitative predictions about relative bias. Thus, estimation of the operative D matrix ought to be a routine feature of empirical studies comparing individual and group bias. Such methods can be very usefully augmented by direct manipulations of such factors as the composition of the group (e.g., Tindale et al., 1993) or the content (e.g., Wright et al., 1990) and communication modality (e.g., McGuire et al., 1987) of intragroup communication and by direct assessments of the demonstrability of correctness of judgment alternatives (e.g., Laughlin & Ellis, 1986).

Conclusions

As long as we continue routinely to rely upon groups to make important decisions, it is important to minimize demonstrable bias in group judgment. We have attempted to show several things in this article: (a) that there can be no simple answer to the question, "Which is more biased, individuals or groups?"; (b) that the social decision scheme model offers a framework for identifying and analyzing individual versus group differences in judgment; and (c) that using that framework, we can now specify some of the conditions under which groups are both more and less biased than individuals.

References

Anderson, C. A., Lepper, M. R., & Ross, L. (1980). Perseverance of social theories: The role of explanation in the persistence of discredited information. *Journal of Personality and Social Psychology, 39,* 1037–1049.

Anderson, N. H. (1981). *Foundations of information integration theory.* New York: Academic Press.

Argote, L., Devadas, R., & Melone, N. (1990). The base-rate fallacy: Contrasting processes and outcomes of group and individual judgment. *Organizational Behavior and Human Decision Processes, 46,* 296–310.

Argote, L., Seabright, M. A., & Dyer, L. (1986). Individual versus group use of base-rate and individuating information. *Organizational Behavior and Human Decision Processes, 38,* 65–75.

Arkes, H. R. (1991). Costs and benefits of judgment errors: Implications for debiasing. *Psychological Bulletin, 110,* 486–498.

Arkes, H., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes, 35,* 125–140.

Baron, R. S. (1986). Distraction-conflict theory: Progress and problems. In L. Berkowitz (Ed.), *Advances in experimental social psychology,* Vol. 19 (pp. 1–40). New York: Academic Press.

Bray, R. M., Struckman-Johnson, C., Osborne, M. D., McFarlane, J. B., & Scott, J. (1978). The effects of defendant status on decisions of student and community juries. *Social Psychology, 41,* 256–260.

Brockner, J., & Rubin, J. (1985). *Entrapment in escalating conflict: A social psychological analysis.* New York: Springer-Verlag.

Burnstein, E., & Vinokur, A. (1977). Persuasive argumentation and social comparison as determinants of attitude polarization. *Journal of Experimental Social Psychology, 13,* 315–332.

Camerer, C. (1992). The rationality of prices and volume in experimental markets. *Organizational Behavior and Human Decision Processes, 51,* 237–272.

Carretta, T. R., & Moreland, R. L. (1983). The direct and indirect effects of inadmissible evidence. *Journal of Applied Social Psychology, 13,* 291–309.

Carroll, J. S., Kerr, N. L., Alfini, J., Weaver, F., MacCoun, R., & Feldman, V. (1986). Free press and fair trial: The role of behavioral research. *Law and Human Behavior, 10,* 187–202.

Chalos, P., & Pickard, S. (1985). Information choice and cue use: An experiment in group information processing. *Journal of Applied Psychology, 70,* 634–641.

Dane, F., & Wrightsman, L. (1982). Effects of defendants' and victims' characteristics on jurors' verdicts. In N. Kerr & R. Bray (Eds.), *The psychology of the courtroom.* New York: Academic Press.

Davis, J. H. (1969). *Group performance.* Reading, MA: Addison-Wesley.

Davis, J. H. (1973). Group decision and social interaction: A theory of social decision schemes. *Psychological Review, 80,* 97–125.

Davis, J. H. (1980). Group decision and procedural justice. In M. Fishbein (Ed.), *Progress in social psychology* (pp. 157–229). Hillsdale, NJ: Erlbaum.

Davis, J. H. (1982). Social interaction as a combinatorial process in group decision. In H. Brandstätter, J. H. Davis, & G. Stocker-Kreichgauer (Eds.), *Group decision making.* London: Academic Press.

Davis, J. H. (1996). Group decision making and quantitative judgments: A consensus model. In E. Witte & J. H. Davis (Eds.), *Understanding group behavior: Consensual action by small groups* (Vol. 1, pp. 35–60). Hillsdale, NJ: Erlbaum.

Davis, J. H., Hornik, J., & Hornseth, J. P. (1970). Group decision schemes and strategy preferences in a sequential response task. *Journal of Personality and Social Psychology, 15,* 397–408.

Davis, J. H., & Kerr, N. L. (1986). Thought experiments and the problem of sparse data in small-group performance research. In P. Goodman (Ed.), *Designing effective work groups* (pp. 305–349). New York: Jossey-Bass.

Davis, J. H., Kerr, N. L., Sussmann, M., & Rissman, A. K. (1974). Social decision schemes under risk. *Journal of Personality and Social Psychology, 30,* 248–271.

Davis, J. H., Spitzer, C. E., Nagao, D. H., & Stasser, G. (1978). Bias in social decisions by individuals and groups: An example from mock juries. In H. Brandstätter, J. H. Davis, & H. Schuler (Eds.), *Dynamics of group decisions* (pp. 33–52). Beverly Hills, CA: Sage.

Davis, J. H., Tindale, R. S., Nagao, D. H., Hinsz, V. B., & Robertson,

B. (1984). Order effects in multiple decisions by groups: A demonstration with mock juries and trial procedures. *Journal of Personality and Social Psychology, 47,* 1003–1012.

Dawes, R. M. (1988). *Rational choice in an uncertain world.* San Diego, CA: Harcourt Brace Jovanovich.

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward solution of a riddle. *Journal of Personality and Social Psychology, 53,* 497–509.

Dunning, D., Griffin, D. W., Milojkovic, J., & Ross, L. (1990). The overconfidence effect in social prediction. *Journal of Personality and Social Psychology, 58,* 568–581.

Dunning, D., & Ross, L. (1992). *Overconfidence in individual and group prediction: Is the collective any wiser?* Unpublished manuscript, Cornell University.

Edwards, W. (1968). Conservatism in human information processing. In B. Kleinmuntz (Ed.), *Formal representation of human judgment.* New York: Wiley.

Einhorn, H. J., Hogarth, R. M., & Klempner, E. (1977). Quality of group judgment. *Psychological Bulletin, 84,* 158–172.

Ericsson, K. A., & Simon, H. A. (1993). Protocol analysis: Verbal reports as data. Cambridge, MA: MIT Press.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7,* 117–140.

Funder, D. C. (1987). Errors and mistakes: Evaluating the accuracy of social judgment. *Psychological Bulletin, 101,* 75–90.

Gelfand, A. E., & Solomon, H. (1974). Analyzing the decision making processes of the American jury. *Journal of the American Statistical Association, 70,* 305–309.

Greene, E., & Loftus, E. F. (1985). When crimes are joined at trial. *Law and Human Behavior, 9,* 193–207.

Greenwald, A. G. (1980). The totalitarian ego: Fabrication and revision of personal history. *American Psychologist, 35,* 603–618.

Grofman, B. (1978). Judgmental competence of individuals and groups in a dichotomous choice situation: Is a majority of heads better than one? *Journal of Mathematical Sociology, 6,* 47–60.

Hans, V. P., & Doob, A. N. (1976). Section 12 of the Canada Evidence Act and the deliberations of simulated juries. *Criminal Law Quarterly, 18,* 235–254.

Harkins, S., & Petty, R. E. (1982). Effects of task difficulty and task uniqueness on social loafing. *Journal of Personality and Social Psychology, 43,* 1214–1230.

Harkins, S., & Szymanski, K. (1987). Social loafing and social facilitation: New wine in old bottles. In C. Hendrick (Ed.), *Group processes and intergroup relations. Review of personality and social psychology* (Vol. 9, pp. 167–188). Newbury Park, CA: Sage.

Hartwick, J., Sheppard, B., & Davis, J. H. (1982). Group remembering: Research and implications. In R. A. Guzzo (Ed.), *Improving group decision making in organizations: Approaches from theory and research* (pp. 41–72). New York: Academic Press.

Hastie, R. (1986). Review essay: Experimental evidence on group accuracy. In B. Grofman & G. Guillermo (Eds.), *Information pooling and group decision making* (Vol. 2, pp. 129–157). Greenwich, CT: JAI Press.

Hastie, R., Penrod, S., & Pennington, N. (1983). *Inside the jury.* Cambridge, MA: Harvard University Press.

Hastie, R., & Rasinski, K. A. (1988). The concept of accuracy in social judgment. In D. Bar-Tal & A. W. Kruglanski (Eds.), *The social psychology of knowledge* (pp. 193–208). Cambridge, England: Cambridge University Press.

Hawking, S. W. (1988). *A brief history of time.* New York: Bantam Books.

Hawkins, S. A., & Hastie, R. (1990). Hindsight: Biased judgments of past events when outcomes are known. *Psychological Bulletin, 107,* 311–327.

Higgins, E. T., Rholes, W. S., & Jones, C. R. (1977). Category accessibility and impression formation. *Journal of Experimental Social Psychology, 13,* 141–154.

Hill, G. W. (1987). Group versus individual performance: Are N + 1 heads better than one? *Psychological Bulletin, 91,* 517–539.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (in press). The emerging conceptualization of groups as information processors. *Psychological Bulletin.*

Hoffman, L. R. (1979). *The group problem solving process: Studies of a valence model.* New York: Praeger.

Hogarth, R. M. (1990). *Insights in decision making: A tribute to Hillel J. Einhorn.* Chicago: University of Chicago Press.

Hogarth, R. M., & Reder, M. W. (1987). *Rational choice: The contrast between economics and psychology.* Chicago: University of Chicago Press.

Irwin, J. R., & Davis, J. H. (1995). Choice/matching preference reversals in groups: Consensus processes and justification-based reasoning. *Organizational Behavior and Human Decision Processes, 64,* 325–339.

Izzett, R. R., & Leginski, W. (1974). Group discussion and the influence of defendant characteristics in a simulated jury setting. *Journal of Social Psychology, 93,* 271–279.

Janis, I. L. (1982). *Groupthink* (2nd ed.). Boston: Houghton-Mifflin.

Johnson, C. D., & Davis, J. H. (1972). An equiprobability model of risk-taking. *Organizational Behavior and Human Performance, 8,* 159–175.

Jones, E. E., & Harris, V. A. (1967). The attribution of attitudes. *Journal of Experimental Social Psychology, 3,* 1–24.

Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases.* New York: Cambridge University Press.

Kahneman, D., & Tversky, A. (1972). Subjective probability: An analysis of decision under risk. *Cognitive Psychology, 3,* 430–454.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist, 39,* 341–350.

Kalven, H., & Zeisel, H. (1966). *The American jury.* Boston: Little-Brown.

Kameda, T., & Davis, J. H. (1990). The function of the reference point in individual and group risk decision making. *Organizational Behavior and Human Decision Processes, 46,* 55–76.

Kaplan, M. F. (1982). Cognitive processes in the individual juror. In N. Kerr & R. Bray (Eds.), *The psychology of the courtroom* (pp. 197–220). New York: Academic Press.

Kaplan, M. F., & Miller, L. E. (1978). Reducing the effects of juror bias. *Journal of Personality and Social Psychology, 36,* 1443–1455.

Kaplan, M. F., & Schersching, C. (1980). Reducing juror bias: An experimental approach. In P. Lipsitt & B. Sales (Eds.), *New directions in psycholegal research.* New York: Van Nostrand-Reinhold.

Kenny, D. A., Kashy, D. A., & Bolger, N. (in press). Data analysis in social psychology. In D. Gilbert, S. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed.). New York: McGraw-Hill.

Kerr, N. L. (1981). Social transition schemes: Charting the group's road to agreement. *Journal of Personality and Social Psychology, 41,* 684–702.

Kerr, N. L. (1982). Social transition schemes: Model, method, and applications. In H. Brandstätter, J. Davis, & G. Stocker-Kreichgauer (Eds.), *Group decision making.* London: Academic Press.

Kerr, N. L. (1983). Motivation losses in task-performing groups: A social dilemma analysis. *Journal of Personality and Social Psychology, 45,* 819–828.

Kerr, N. L. (1992). Group decision making at a multialternative task: Extremity, interfaction distance, pluralities, and issue importance. *Organizational Behavior and Human Decision Processes, 52,* 64–95.

Kerr, N. L., Atkin, R., Stasser, G., Meek, D., Holt, R., & Davis, J. H.

(1976). Guilt beyond a reasonable doubt: Effects of concept definition and assigned decision rule on the judgments of mock jurors. *Journal of Personality and Social Psychology, 34,* 282–294.

Kerr, N. L., Davis, J. H., Atkin, R., Holt, R., & Meek, D. (1975). Group position as a function of member attitudes: Choice shift effects from the perspective of social decision scheme theory. *Journal of Personality and Social Psychology, 35,* 574–593.

Kerr, N. L., & Huang, J. Y. (1986). Jury verdicts: How much difference does one juror make? *Personality and Social Psychology Bulletin, 12,* 325–343.

Kerr, N. L., MacCoun, R. J., & Kramer, G. P. (1996). When are N heads better than one?: Bias in individuals vs. groups. In E. Witte & J. H. Davis (Eds.) *Understanding group behavior: Consensual action by small groups* (Vol. 1, pp. 105–136). Hillsdale, NJ: Erlbaum.

Kerr, N. L., Stasser, G., & Davis, J. H. (1979). Model-testing, model-fitting, and social decision schemes. *Organizational Behavior and Human Performance, 23,* 339–410.

Kerwin, J., & Shaffer, D. R. (1994). Mock jurors versus mock juries: The role of deliberations in reactions to inadmissible testimony. *Personality and Social Psychology Bulletin, 20,* 153–162.

Klevorick, A. K., & Rothschild, M. A. (1979). A model of the jury decision process. *Journal of Legal Studies, 8,* 141–161.

Kramer, G. P., Kerr, N. L., & Carroll, J. S. (1990). Pretrial publicity, judicial remedies, and jury bias. *Law and Human Behavior, 14,* 409–438.

Latané, B. (1981). The psychology of social impact. *American Psychologist, 36.* 343–356.

Latané, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology, 37,* 822–832.

Laughlin, P. R. (1980). Social combination process of cooperative, problem-solving groups at verbal intellective tasks. In M. Fishbein (Ed.), *Progress in Social Psychology* (Vol. 1, pp. 127–155). Hillsdale, NJ: Erlbaum.

Laughlin, P. R., & Earley, P. C. (1982). Social combination models, persuasive arguments theory, social comparison theory, and choice shift. *Journal of Personality and Social Psychology, 42,* 273–280.

Laughlin, P. R., & Ellis, A. L. (1986). Demonstrability and social combination processes on mathematical intellective tasks. *Journal of Experimental Social Psychology, 22,* 17–189.

Laughlin, P. R., Kerr, N. L., Davis, J. H., Halff, H. M., & Marciniak, K. A. (1975). Group size, member ability, and social decision schemes on an intellective task. *Journal of Personality and Social Psychology, 31,* 522–535.

Laughlin, P. R., Kerr, N. L., Munch, M., & Haggerty, C. A. (1976). Social decision schemes of the same four-person groups on two different intellective tasks. *Journal of Personality and Social Psychology, 33,* 80–88.

Laughlin, P. R., & Shippy, T. A. (1983). Collective induction. *Journal of Personality and Social Psychology, 45,* 94–100.

Laughlin, P. R., & Sweeney, J. D. (1977). Individual-to-group and group-to-individual transfer in problem solving. *Journal of Experimental Psychology: Human Learning & Memory, 3,* 246–254.

Levine, J. M., & Resnick, L. B. (1993). Social foundations of cognition. *Annual Review of Psychology, 44,* 585–612.

Lichtenstein, S., Fischhoff, B., & Phillips, L. D. (1982). Calibration of probabilities: The state of the art to 1980. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 306–334). New York: Cambridge University Press.

Lichtenstein, S., & Slovic, P. (1971). Reversals of preference between bids and choices in gambling decisions. *Journal of Experimental Psychology, 89,* 46–55.

Lorge, I., & Solomon, H. (1955). Two models of group behavior in the solution of eureka-type problems. *Psychometrika, 20,* 139–148.

MacCoun, R. J. (1990). The emergence of extralegal bias during jury deliberation. *Criminal Justice and Behavior, 17,* 303–314.

MacCoun, R. J., & Kerr, N. L. (1988). Asymmetric influence in mock jury deliberation: Jurors' bias for leniency. *Journal of Personality and Social Psychology, 54,* 21–33.

MacCoun, R. J., & Tyler, T. R. (1988). The basis of citizens' perceptions of the criminal jury: Procedural fairness, accuracy and efficiency. *Law and Human Behavior, 12,* 333–352.

Maheswaran, D., & Chaiken, S. (1991). Promoting systematic processing in low-motivation settings: Effect of incongruent information on processing and judgment. *Journal of Personality & Social Psychology, 61,* 13–25.

McGrath, J. E. (1984). *Groups: Interaction and performance.* Englewood Cliffs, NJ: Prentice-Hall.

McGuire, T. W., Kiesler, S., & Siegel, J. (1987). Group and computer-mediated discussion effects in risk decision making. *Journal of Personality and Social Psychology, 52,* 917–930.

Meehl, P. E. (1990). Appraising and amending theories: The strategy of Lakatosian defense and two principles that warrant it. *Psychological Inquiry, 1,* 108–141.

Miller, C. E. (1989). The social psychological effects of group decision rules. In P. B. Paulus (Ed.), *Psychology of group influence* (2nd ed., pp. 327–355). Hillsdale, NJ: Erlbaum.

Mowen, J. C., & Gentry, J. W. (1980). Investigation of the preference-reversal phenomenon in a new product introduction task. *Journal of Applied Psychology, 65,* 715–722.

Myers, D. G. (1980). *The inflated self.* New York: Seabury Press.

Myers, D. G., & Kaplan, M. F. (1976). Group-induced polarization in simulated juries. *Personality and Social Psychology Bulletin, 2,* 63–66.

Myers, D. G., & Lamm, H. (1976). The group polarization phenomenon. *Psychological Bulletin, 83,* 602–627.

Nagao, D. H., & Davis, J. H. (1980). Some implications of temporal drift in social parameters. *Journal of Experimental Social Psychology, 16,* 479–496.

Nagao, D. H., Tindale, R. S., Hinsz, V. B., & Davis, J. H. (1985, August). *Individual and group biases in information processing.* Paper presented at the meeting of the American Psychological Association, Los Angeles.

Neale, M. A., Bazerman, M. H., Northcraft, G. B., & Alperson, C. (1986). 'Choice shift' effects in group decisions: A decision bias perspective. *International Journal of Small Group Research, 23,* 33–42.

Nisbett, R. E. (1993). *Rules for reasoning.* Hillsdale, NJ: Erlbaum.

Nisbett, R. E., & Borgida, E. (1975). Attribution and the psychology of prediction. *Journal of Personality and Social Psychology, 32,* 932–943.

Nisbett, R., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, NJ: Prentice Hall.

Paese, P. W., Bieser, M., & Tubbs, M. E. (1993). Framing effects and choice shifts in group decision making. *Organizational Behavior and Human Decision Processes, 56,* 149–165.

Page, B. I., & Shapiro, R. Y. (1992). *The rational public: Fifty years of trends in Americans' policy preferences.* Chicago: University of Chicago Press.

Pelham, B. W., & Neter, E. (1995). The effect of motivation of judgment depends on the difficulty of the judgment. *Journal of Personality and Social Psychology, 68,* 581–594.

Penrod, S., & Hastie, R. (1980). A computer simulation of jury decision making. *Psychological Review, 87,* 133–159.

Petty, R. E., & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change.* New York: Springer Verlag.

Plott, C. R. (1986). Rational choice in experimental markets. In R. M. Hogarth & M. W. Reder (Eds.), *Rational choice: The contrast be-*

tween economics and psychology (pp. 117–144). Chicago: University of Chicago Press.

Plous, S. (1995). A comparison of strategies for reducing interval overconfidence in group judgments. *Journal of Applied Psychology, 80,* 443–454.

Rosenwein, R. E., & Campbell, D. T. (1992). Mobilization to achieve collective action and democratic majority/plurality amplification. *Journal of Social Issues, 48,* 125–138.

Schumann, E. L., & Thompson, W. C. (1989). *Effects of attorneys' arguments on jurors' use of statistical evidence.* Unpublished manuscript, University of California at Irvine.

Shafir, E., Simonson, I., & Tversky, A. (1993). Reason-based choice. *Cognition, 49,* 11–36.

Shaw, M. E. (1932). Comparison of individuals and small groups in the rational solution of complex problems. *American Journal of Psychology, 44,* 491–504.

Sniezek, J. A., & Henry, R. A. (1989). Accuracy and confidence in group judgment. *Organizational Behavior and Human Decision Processes, 43,* 1–28.

Stahlberg, D., Eller, F., Maass, A., & Frey, D. (1995). We knew it all along: Hindsight bias in groups. *Organizational Behavior and Human Decision Processes, 63,* 46–58.

Stasser, G., & Davis, J. H. (1981). Group decision making and social influence: A social interaction sequence model. *Psychological Review, 88,* 523–551.

Stasser, G., Kerr, N., & Bray, R. (1982). The social psychology of jury deliberations: Structure, process, and product. In N. Kerr & R. Bray (Eds.), *The psychology of the courtroom* (pp. 221–256). New York: Academic Press.

Stasser, G., Kerr, N. L., & Davis, J. H. (1989). Influence processes and consensus models in decision-making groups. In P. Paulus (Ed.), *Psychology of group influence* (2nd ed.). Hillsdale, NJ: Erlbaum.

Stasser, G., & Stewart, D. (1992). Discovery of hidden profiles by decision-making groups: Solving a problem versus making a judgment. *Journal of Personality and Social Psychology, 63,* 426–434.

Stasser, G., Taylor, L. A., & Hanna, C. (1989). Information sampling in structured and unstructured discussion of three- and six-person groups. *Journal of Personality and Social Psychology, 57,* 67–78.

Stasser, G., & Titus, W. (1985). Pooling of unshared information in group decision making: Biased information sampling during group discussion. *Journal of Personality and Social Psychology, 48,* 1467–1478.

Stasser, G., & Titus, W. (1987). Effects of information load and percentage shared information on the dissemination of unshared information during discussion. *Journal of Personality and Social Psychology, 53,* 81–93.

Stasson, M. F., Ono, K., Zimmerman, S. K., & Davis, J. H. (1988). Group consensus processes on cognitive bias tasks: A social decision scheme approach. *Japanese Psychological Research, 30,* 68–77.

Tanford, S., & Penrod, S. (1984). Social inference processes in juror judgments of multiple-offense trials. *Journal of Personality and Social Psychology, 47,* 749–765.

Taylor, D. W. (1954). Problem solving by groups. *Proceedings of the XIV International Congress of Psychology* (pp. 218–219). Amsterdam: North Holland Publishing.

Thaler, R. H. (1991). *Quasi rational economics.* New York: Russell Sage.

Thibaut, J., & Strickland, L. (1956). Psychological set and social conformity. *Journal of Personality, 25,* 115–129.

Thompson, W. C., Fong, G. T., & Rosenhan, D. L. (1981). Inadmissible evidence and juror verdicts. *Journal of Personality and Social Psychology, 40,* 453–463.

Tindale, R. S. (1992). Assembly bonus effect or typical group performance? A comment on Michaelsen, Watson, and Black (1989). *Journal of Applied Psychology, 77,* 102–105.

Tindale, R. S. (1993). Decision errors made by individuals and groups. In N. J. Castellan (Ed.), *Individual and group decision making: Current issues* (pp. 109–124). Hillsdale, NJ: Erlbaum.

Tindale, R. S., Filkins, J., Thomas, L. S., & Smith, C. M. (1993, November). *An attempt to reduce conjunction errors in decision-making groups.* Paper presented at the annual meeting of the Society for Judgment and Decision Making, Washington, DC.

Tindale, R. S., & Nagao, D. H. (1986). An assessment of the potential utility of "scientific jury selection": A "thought experiment" approach. *Organizational Behavior and Human Decision Processes, 37,* 409–425.

Tindale, R. S., Sheffey, S., & Filkins, J. (1990). *Conjunction errors by individuals and groups.* Paper presented at the meetings of the Society for Judgment and Decision Making, New Orleans, LA.

Tindale, R. S., Sheffey, S., & Scott, L. A. (1993). Framing and group decision-making: Do cognitive changes parallel preference changes? *Organizational Behavior and Human Decision Processes, 55,* 470–485.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211,* 453–458.

Tversky, A., & Kahneman, D. (1983). Extensional vs. intuitive reasoning: The conjunction fallacy in probability judgments. *Psychological Review, 90,* 293–315.

Tversky, A., Sattath, S., & Slovic, P. (1988). Contingent weighting in judgment and choice. *Psychological Review, 95,* 371–384.

Vinokur, A., & Burnstein, E. (1973). Effects of partially shared persuasive arguments on group-induced shifts: A group-problem-solving approach. *Journal of Personality and Social Psychology, 29,* 305–315.

Vollrath, D. A., Sheppard, B. H., Hinsz, V., & Davis, J. H. (1989). Memory performance by decision-making groups and individuals. *Organizational Behavior and Human Decision Processes, 43,* 289–300.

Wegner, D. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behavior* (pp. 185–208). New York: Springer-Verlag.

Wells, G. L., Miene, P. K., & Wrightsman, L. S. (1985). The timing of the defense opening statement: Don't wait until the evidence is in. *Journal of Applied Social Psychology, 15,* 758–772.

Whyte, G. (1993). Escalating commitment in individual and group decision making: A prospect theory approach. *Organizational Behavior and Human Decision Processes, 54,* 430–455.

Wittenbaum, G. M., & Stasser, G. (1995). The role of prior expectancy and group discussion in the attribution of attitudes. *Journal of Experimental Social Psychology, 31,* 82–105.

Wright, E. F., & Christie, S. D. (1990). *The impact of group discussion on the theory-perseverance bias.* Unpublished manuscript, St. Francis Xavier University.

Wright, E. F., Lüüs, C. E., & Christie, S. D. (1990). Does group discussion facilitate the use of consensus information in making causal attributions? *Journal of Personality and Social Psychology, 59,* 261–269.

Wright, E. F., & Wells, G. L. (1985). Does group discussion attenuate the dispositional bias? *Journal of Applied Social Psychology, 15,* 531–546.

Zajonc, R. B. (1962). A note on group judgments and group size. *Human Relations, 15,* 177–180.

Zajonc, R. B. (1965). Social facilitation. *Science, 149,* 269–274.

Zajonc, R. B., Wolosin, R. J., Wolosin, M. A., & Sherman, S. J. (1968). Individual and group risk taking in a two-choice situation. *Journal of Experimental Social Psychology, 4,* 84–106.

Zanzola, L. (1977). *Effects of pretrial publicity on the verdicts of jurors and juries.* Unpublished master's thesis, Northern Illinois University.

Appendix A

Illustrations of Processes Arising in Interpersonal–Group Context

Group task demands
- Concern with maintaining group harmony
- Impression-management concerns
- Need to achieve consensus (satisfy decision rule)
- Style of deliberation
- Etc. . . .

Effects of group context and capacity on information processing

Group attention
- Distraction
- Social loafing
- Social facilitation
- Etc. . . .

Group encoding
- Social priming
- Social consensus on meaning
- Etc. . . .

Group storage
- Multiple, parallel storage
- Transactive, distributed memory
- Etc. . . .

Group retrieval
- Socially cued recall
- Multiple parallel recall
- Transactive, distributed recall
- Retrieval bias against unshared information
- Etc. . . .

Group processing
- Parallel processing
- Assembly effect bonuses
- Error checking
- Integration of multiple judgments
- Demonstrability of solutions
- Production blocking
- Social comparison of judgments
- Etc. . . .

Group consensus requirements–Processes
- Compliance/conformity
- Compromise alternatives
- Accede to implicit or explicit decision rule
- Etc. . . .

Appendix B

Generating the Asymmetric Social Decision Scheme Matrix

The function used to generate the elements of a strongly asymmetric social decision scheme was

$$d_{iA} = \begin{cases} \alpha - \dfrac{\alpha(\chi - \alpha)^{\beta}}{\alpha^{\beta}} & \text{when } \chi \leq \alpha, \\[2ex] \dfrac{(1 - \alpha)(\chi - \alpha)^{\beta}}{(1 - \alpha)^{\beta}} + \alpha & \text{when } \chi \geq \alpha, \end{cases} \tag{B1}$$

where

$$(r_{iA}, r_{iB}) = (r + 1 - i, i - 1),$$

$$\chi = \frac{(i - 1)}{r}, \text{ and}$$

$$\beta = \frac{1}{2K + 1}.$$

In these computations, α and K were free parameters, where $0 \leq \alpha \leq 1.0$ and K could take on a nonnegative integer value. When $\alpha = .50$, the D matrix was symmetric. For $\alpha < .5$, the resulting asymmetry favored alternative G, while $\alpha > .5$ resulted in an asymmetry favoring alternative NG. The value of α also represented the inflection point in the function in Equation 4. In the present study, the strongly asymmetric D matrix used $\alpha = .85$. The smaller the K value, the smoother, less inflected the function in Equation 4. When $K = 0$, this function simply becomes the proportionality decision scheme (i.e., $\beta = 1$ and $d_{iA} = \chi$, the proportion of group members advocating alternative A); as $K \rightarrow \infty$, this function approaches a step-function breaking at α; for example, simple majority is produced when $\alpha = .5$ and $K = \infty$. In the strongly asymmetric D used in this article, $K = 5$.

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