14 Cognitions, Preferences, and Social Sharedness: Past, Present, and Future Directions in Group Decision Making

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ABSTRACT

Research on group decision making has focused on how group-member preference distributions map into group-level preferences. One of the key findings from this research is that majority/plurality factions tend to control the group's final decision. Thus, preferences shared by most of the group members tend to become the group's preference. Findings at the cognitive level have also shown that the degree to which cognitions are shared among members affects group decisions. These sociocognitive processes tend to work in concert with the social processes concerning preferences, but they can either enhance or counter preference-level faction size effects. Additionally, socially shared cognitions can both improve and impede group decision performance. This chapter attempts to review key aspects of the group decision-making literature, focusing both at the preference level and at the cognitive level. Similarities between the findings at both levels are explored in relation to the importance of social sharedness for group performance.

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Preparation of this chapter was supported by the Japanese Ministry of Education, Science, Sports, and Culture Grant 11610096 (Tatsuya Kameda, Principal Investigator), National Science Foundation Grant SBR 9730822 (R. Scott Tindale, Principal Investigator), and National Science Foundation Grant SBR 9507955 (James H. Davis, Co-Principal Investigator).

Research on group decision making has several distinctive roots in the social sciences. Besides psychological and sociological approaches to how people make decisions as a collective (e.g., Coleman, 1990; Witte & Davis, 1996), group decision making has been a major research topic in the interdisciplinary area of *social choice theory*, in which economics and political science intersect (Arrow, 1963; Black, 1958; Fishburn, 1973; Ordeshook, 1986). Although these disciplines differ in many ways in terms of how and on what to focus (e.g., empirical versus analytical emphasis, consensus versus choice), perhaps one of the most profound differences is how they characterize *legitimate* inputs for collective choices – what elements are regarded as acceptable inputs to render group decisions (e.g., preference orders, intensity of preferences, justifications).

In this chapter, we start with a discussion of this legitimate input issue. We then demonstrate that distinguishing two levels of inputs, namely, preference and cognition, provides a useful overarching conceptual picture for synthesizing our empirical knowledge about decision making in consensus groups. In so doing, we also show that, at both levels, social sharedness plays a vital, perhaps the most critical, role in determining actual consensus processes and outcomes. *Social sharedness* here refers to the degree to which preferences and cognitions are shared among members at the outset of group interaction (cf. Tindale & Kameda, 2000). We argue that this notion serves as a common thread for understanding various features of group decision making and also as a useful heuristic guide for future research endeavors.

Two Natural Levels in Social Aggregation

Social Choice versus Consensus

To discuss the legitimate input issue in group decision making, let us first think about aggregation processes in a *public choice* such as an election.

As exemplified by a single-ballot system, almost all aggregation methods in public choice situations regard any background information other than preferences to be irrelevant. The only legitimate input for collective choice is individual *preference* (most typically a preference order), formally represented by a vote. More specifically, as far as it is expressed, any vote (whether it is a well-thought-out choice or a capricious one, whether it represents a strong preference or a weak preference, etc.) counts exactly the same in the social aggregation operation. Such a treatment of preference as the supreme (or untouchable) unit in social decision making dates back to the ideas of 18th-century theorists, including Condorcet, Borda, and others, and has been accepted as the standard view in the modern social choice literature (see Mueller, 1989, for a recent review). Furthermore, as Sen (1977) suggests, it is generally unrealistic in a large-scale election to consider a social aggregation mechanism that incorporates inputs other than expressed preferences (i.e., votes).

However, despite its theoretical clarity and practical usefulness in many public choice situations, the notion of supremacy of preferences is not so well established in an everyday group decision-making context featuring a face-to-face interaction (e.g., the committee). In consensual decision making, people tend to presume some background information to play special functions beyond mere preferences. Indeed, people's trust in and justification for the use of consensual decision making seem to rest on this presumption in an essential way – an intuitive but strong belief that cognitive/affective components underlying preferences can be or should be shared among group members through face-to-face dialogue.

Verdict-Driven versus Evidence-Driven Process

Hastie, Penrod, and Pennington's (1983) observation about jury decision making illustrates this legitimate input issue well. These researchers identified two contrasting aggregation styles, verdict-driven versus evidence-driven, in mock jury deliberation. The *verdict-driven* style refers to a consensus process in which a jury is divided into factions based on verdict preferences from the outset of deliberation. Typically, these juries open deliberations with a public ballot; jurors then act as advocates for their positions, aligned in opposing factions by expressed preferences. The *verdict-driven* juries conduct polling frequently until they reach a final verdict.

In contrast, the *evidence-driven* style refers to a deliberation process in which jurors collaborate to review evidence closely and try to reach a common understanding of what actually happened in the focal case. Instead of aligning themselves into opposing factions by verdict preferences, these jurors focus on constructing the single most credible story that summarizes the events at the time of the alleged crime; verdict statements and polling typically do not occur until later in deliberation.

From our perspective, the preceding Hastie et al. observation illustrates *dual meanings of "consensus."* Just as individual preferences serve as natural inputs for consensus (e.g., the verdict-driven process), individual cognitions or knowledge representations serve as meaningful inputs as well (e.g., the evidence-driven process). Preferences and cognitions are both treated as legitimate inputs (notably, sometimes the latter being even more legitimate) in consensual decision making.

A question arises about what this duality implies for group decision making. Although cognitions or knowledge representations are often related to preferences, their mapping is usually imperfect. Then how is group decision making characterized when we regard *preference* as a unit of social aggregation and when we regard *cognition* or *knowledge* as a unit of aggregation? Are different mechanisms in operation at each level of the social aggregations or does the same type of social mechanism govern the aggregations in general? In the following, we examine representative theories and empirical research in the small group decision-making literature from this dual perspective.

Aggregation at the Preference Level

Social Decision Scheme Model

Just as preference structures over alternatives dominated the early individual decision-making literature, the process of aggregating the preferences of group members in order to achieve consensus has played a major role in theory and research on group decision making. Probably the most comprehensive conceptual system for describing such aggregation processes is Davis's (1973, 1996; Stasser, Kerr, & Davis, 1989) Social Decision Scheme (SDS) theory. SDS theory starts with the assumption that small group interaction can be seen as a *combinatorial process* wherein preferences for decision alternatives across group members must be combined in such a way as to allow the group to reach consensus on a single group choice. This combinatorial process can vary as a function of the group task, the environment, and other factors and is described in terms of an SDS matrix.

In the general case, the theory assumes that an individual decision maker must select one of n mutually exclusive and exhaustive response alternatives, A_j, $j = 1, 2, 3, \ldots, n$. It also assumes that individual decisions are characterized by a discrete probability distribution, $p = (p_1, p_2, \ldots, p_n)$, over n alternatives, and similarly for groups, $P = (P_1, P_2, \ldots, P_{n'})$. However, situations are possible (e.g., jury decisions) where $n \neq n'$, in that the number of response outcomes for groups, $n' = 3$ (i.e., guilty, not guilty, hung), may differ from the number, $n = 2$ (i.e., guilty, not guilty), defined for individuals. Prior to discussion, the r individual group members may array themselves over the n response alternatives in

$$C(n + r - 1; r) = \frac{(n + r - 1)!}{r!(n - 1)!}$$

different ways. For example, the members of a six-person group can array themselves over two choice alternatives in seven different ways, that is, (6, 0), (5, 1), ..., (0, 6). Such an array is referred to as a *distinguishable distribution*, in which response alternatives but not individual group members are distinguishable, just as in voting. The probability, π_i of the ith distribution, $i = 1, 2, \ldots, m$, of member preferences occurring may be estimated in two different ways. Some applications allow for a direct estimate by counting the relative frequency with which the ith distribution is observed to occur (e.g., inspecting prediscussion preferences within the group). In other cases, π_i must be estimated indirectly using the multinomial distribution

$$\pi_i = \binom{r}{r_1, r_2, \ldots, r_n} p_1^{r_1} p_2^{r_2} \cdots p_n^{r_n}$$

using observed estimates for the individual choice probability distribution, $\hat{p}_i$.

Given a particular distribution of opinions in a group, the relevant problem is to ascertain the probability that the group will choose a given alternative. This process is obviously a function of the social interaction, as well as of various prescribed rules or laws governing the particular group. Although the process may be rather complex, it can be given an explicit summary form by defining the conditional probability, d_{ij}, of the group choosing the jth choice alternative given the ith distinguishable distribution. The general statement of the theoretical relation between the initial preference distribution and the final group outcome may be cast as an $m \times n'$ stochastic matrix, D, called a *social decision scheme matrix*.

Table 14.1. *Social Decision Scheme Matrices for Two Models: Proportionality and Majority-Equiprobability Otherwise*

Individual Distribution		Proportionality		Majority-Equiprobability Otherwise	
		Group Distributions			
A	B	A	B	A	B
6	0	1.00	0.00	1.00	0.00
5	1	0.83	0.17	1.00	0.00
4	2	0.67	0.33	1.00	0.00
3	3	0.50	0.50	0.50	0.50
2	4	0.33	0.67	0.00	1.00
1	5	0.17	0.83	0.00	1.00
0	6	0.00	1.00	0.00	1.00

Table 14.1 shows two examples of SDS matrices for six-person groups with two choice alternatives.

The *D* matrices in Table 14.1 represent two different processes. The majority-equiprobability otherwise SDS presupposes that whenever a majority of the members favor a particular decision alternative, that alternative will be chosen by the group. In cases where no majority exists (a 3–3 split), each alternative is equally likely to be the group's choice. The proportionality SDS assumes that the probability that a group will choose a particular alternative is the proportion of members favoring that alternative. Thus, the proportionality SDS assumes that factions within the group are only as powerful as the relative size of that faction, whereas the majority-equiprobability otherwise model assumes that majority factions are quite powerful and typically define the group's choice. (Of course, when $d_{ij} = .00$ or 1.00, it should be understood that such values represent entries that are actually very near .00 or 1.00.)

Given a particular SDS matrix, the group probability distribution, $P = (P_1, P_2, \ldots, P_{n'})$, is obtained from

$$P = \pi D,$$

where $\pi = (\pi_1, \pi_2, \ldots, \pi_m)$. This general model can be used in two different ways in relation to research on small groups. First, group outcome distributions predicted by any given SDS model can be tested against observed distributions of group decisions. Thus, for example, the predictions from the two models presented in Table 14.1 could be compared against observed data to assess which model better accounts for the data.

This allows for a priori tests of various assumptions underlying how decision-making groups reach consensus. However, the general model can also be used in a model-fitting capacity. Given a particular π vector, an estimated SDS model can be obtained for a specific set of group decision data. Estimated SDS models can be seen as a description of the consensus processes for the particular task/situation in which the data were collected. (For a more detailed and comprehensive discussion of the model-testing vs. model-fitting applications of SDS theory, see Kerr, Stasser, & Davis, 1979.)

The SDS approach has generated a large body of research addressing how groups reach consensus in a variety of decision situations (e.g., Davis, 1980, 1982; Davis, Kameda, Parks, Stasson, & Zimmerman, 1989; Kameda, 1991; Kameda & Sugimori, 1993, 1995; Tindale & Davis, 1983, 1985). Although a number of factors have been found to influence group decision processes (Davis, 1982; Laughlin, 1980), one of the more consistent and robust findings from this research has been that majorities/pluralities win most of the time. This is particularly true when no demonstrably correct alternative exists (Laughlin & Ellis, 1986). When groups cannot demonstrate that a particular alternative is empirically or axiomatically correct (or optimal) during discussion, "correctness" tends to be defined by the group consensus, and larger factions tend to define the group consensus. Majority/plurality-type processes have been observed to describe the consensus process of groups working on a variety of decision tasks/situations, including mock juries (Kameda, 1991; Tindale & Davis, 1983), risk-taking (Davis, Kameda, & Stasson, 1992; Kameda & Davis, 1990), duplex bets (Davis, Kerr, Sussman, & Rissman, 1974), choosing political candidates (Stasser & Titus, 1985), reward allocation decisions (Tindale & Davis, 1985), and hiring job candidates (Tindale, 1989).

Continuous Judgment

One of the limitations of the SDS modeling approach is that it is restricted to decisions defined by discrete decision alternatives. The model does not apply to continuous response formats because the number of distinguishable distributions becomes infinite. Recently, Davis (1996) formulated a continuous judgment model analogous to the SDS model that has many of the same properties discussed previously for majority/plurality models (see also Gigone & Hastie, 1996, for a social judgment theory model for continuous responses). The model, referred to as the

Social Judgment Scheme (SJS) model, is based on position discrepancies (distance among preferences) along the response continuum among the members of a group. The model assumes that the group's decision, G, is a weighted sum of the r members, preferences, x_j, $j = 1, 2, \ldots, r$, where c_j is the weight of the jth member. That is,

$$G = c_1x_1 + c_2x_2 + \cdots + c_rx_r.$$

Given that the members' preferences can be observed a priori, only the weights must be defined further. The consensus weight of the jth member depends on the *centrality* of the member's position relative to other members of the group. The closer that member's position is to other members' positions, the more weight that member is given in defining the group consensus. Thus, the weight of the jth member is defined by

$$c_j = \frac{\sum_{j'=1}^{r} f(|x_j - x_{j'}|)}{\sum_{j=1}^{r}\sum_{j'=1}^{r} f(|x_j - x_{j'}|)}.$$

In the preceding equation, the social influence function is defined as

$$f(|x_j - x_{j'}|) = \exp[-\theta(|x_j - x_{j'}|)], \quad j \neq j'$$

where θ is a positive constant. In practical applications of the model to date, $\theta = 1.00$.

This model tends to give little if any weight to the most discrepant member of the group and fairly heavy weight to the most central member(s). Even though factions per se cannot be defined, the group decision tends to be defined mainly by members who are similar (in proximity along the response dimension) to each other, at the expense of members whose positions are fairly discrepant. Thus, the SJS model essentially assumes a dominant role of central members in guiding the consensus, much like the majority/plurality models discussed previously. Although formulated relatively recently, the model has fared well in empirical tests thus far (Davis, Au, Hulbert, Chen, & Zarnoth, 1997).

Macro Consequences of Consensus Processes Guided by Socially Shared Preferences

As we have seen, group aggregation processes tend to be guided by initial majorities or pluralities in a discrete choice situation, or by members whose opinions are mutually close (i.e., central in the group) in a continuous judgment case, when the demonstrability of a preferred solution is low. In other words, the degree of *social-sharedness* in members' preferences at the onset of the interaction plays a critical role in determining the final consensus outcomes. This is an important observation, because most social decision-making situations that require discussion among people generally fall into this category of ambiguous cases in terms of the demonstrability of solutions. Then, what macro-level consequences are theoretically implied by such processes guided by shared preferences? We think that two macro consequences are particularly important, *group polarization* and *manipulability of group decisions*.

Group Polarization. In the June 1994 election for the European Parliament conducted in Britain, the Labour Party, and the Conservative Party, and the Liberal Democratic Party obtained 44%, 28%, and 17% of the *votes*, and acquired 70%, 20%, and 2% of the *seats*, respectively, in the parliament. The Labour Party, which was relatively advantageous in terms of the number of votes obtained, won the landslide victory in terms of the final seats in the parliament. The electoral system used in this election was a single-seat constituency system coupled with a *plurality* rule.

As readers correctly guess, consensual decision making guided by initial majorities/pluralities produces exactly the same accentuation effect at the group level. To illustrate, let us imagine a hypothetical investment decision-making situation. There are three choice alternatives, which can be ordered in terms of their risk levels – low risk, moderate risk, and high risk. Suppose that an n-member representative committee, randomly chosen from some population, is to discuss this investment issue and to make a final decision. We assume that consensual decision making in this committee is essentially governed by a *majority/plurality process*, as mentioned earlier. Figure 14.1 displays distributions of individual preferences in the population and theoretical distributions of group decisions assuming a simple majority/plurality process.

As Figure 14.1 demonstrates, it is clear that the risky alternative, which is most dominant at the individual level (i.e., the population level), becomes more dominant at the group level, whereas the other weaker alternatives become even weaker at the group level. For example, the most popular, high-risk alternative is supported by 60% of the individuals in the population. The theoretical probability that this alternative will be adopted as a group choice is amplified to 68% in a five-member committee and to 73% in a nine-member committee. On

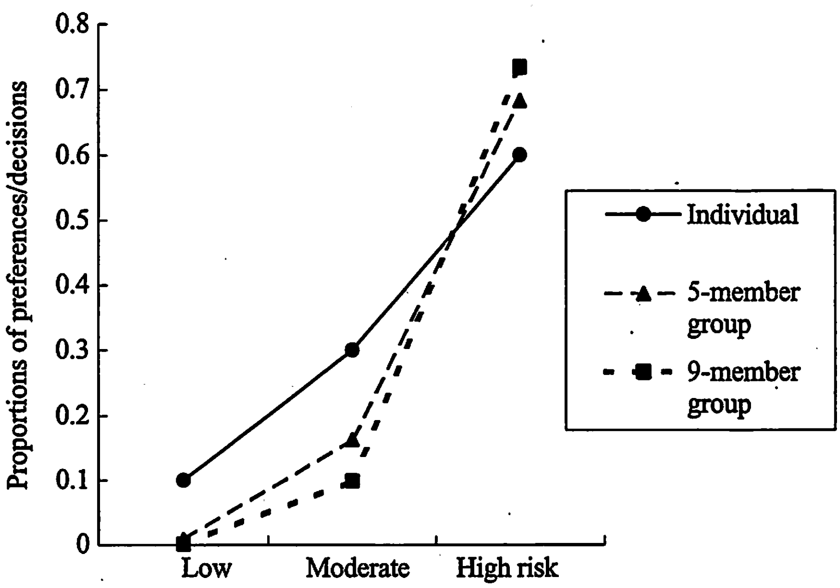

Figure 14.1 Majority/plurality processes and group polarization.

the other hand, the least popular, low-risk alternative (supported by only 10% of the individuals) is adopted as a group choice only .8% of the times by the five-member committee and .08% by the nine-member committee. The change in choice probabilities from the individual level is more evident with the increase in group size, as can be seen from the comparison between the five- and nine-member groups.

Notice that such an accentuation or *group polarization effect* in the micro → macro transformation *never* occurs if group aggregation is summarizable as a *proportionality process* (cf. the left panel of Table 14.1). If proportionality governs the consensus process in the representative committee, the distribution of group choices should be *identical* to the distribution of individual preferences. Furthermore, although the preceding illustration used a discrete choice case, the same argument applies to a continuous judgment case as well. If the aforementioned SJS-like process characterizes group aggregation in the committee, any skewness in the population distribution (i.e., the individual preference distribution) toward a particular end of a response continuum would be exacerbated in the group response distribution due to the higher likelihood of committee members having preferences in the smaller tail. In contrast, a simple *averaging process* in the committee should yield exactly the opposite effect, viz., a *less skewed* distribution at the group level than at the individual level. The group polarization phenomenon, which is observed widely in social decision making beyond risky situations, was a vigorous research topic in social psychology in the 1970s. Although several "individually oriented" explanations have been proposed

(Sanders & Baron, 1977; Vinokur & Burnstein, 1974), notice that our view of this phenomenon focuses directly on the social aggregation process. A consensus process affected by social sharedness (e.g., a majority/plurality or an SJS-like aggregation) can theoretically produce polarization at the group level even when there is no attitude preference change in individuals due to social interaction. Thus, individual attitude change is not a necessary condition for group polarization (see Davis 1973, and Lamm & Myers, 1978, for a further discussion on this point).

Besides their obvious political implications, these group polarization phenomena are important in relation to decision accuracy. Suppose that a focal group decision task may potentially trigger some *cognitive bias* (cf. Kahneman, Slovic, & Tversky, 1982). If there is no external evidence proving why biased preferences are wrong, and/or if members lack logical or statistical backgrounds to understand those corrective arguments, then consensual processes would essentially be determined by shared preferences at the outset of the interaction. Then the quality of group decisions should depend on what kinds of preferences are shared at the outset in a given group stochastically. In this sense, the probability of an individual member's *biased* preference is a key. If this individual probability is larger than a critical social threshold (e.g., 50% in the case of a simple majority process), then consensual decision making leads groups astray. Improvement by grouping is expected only when the individual bias-proneness is smaller than the social threshold (cf. Kerr, MacCoun, & Kramer, 1996). Furthermore, as can be seen in the comparison of the five- and nine-member groups in Figure 14.1, increasing the group size accentuates such a group polarization tendency even further. Using a larger group means that the variance of group-decision qualities is also enlarged statistically – either a great success or a fiasco, depending on the size of individual bias-proneness relative to the critical social threshold in a focal context.

Manipulability of Group Decisions. Another important implication of a consensus process guided by shared preferences is procedural manipulability of group outcomes. The most famous example of this sort, focusing particularly on majority/plurality aggregation, is Condorcet's voting paradox. When a group decides among three or more alternatives (say x, y, and z), cyclical majorities can exist. For example, if members' preference orders are $x > y > z$, $y > z > x$, and $z > x > y$, respectively, in a three-person group, the majority in the group (two of three members) prefer x over y, y over z, and z over x. Thus, cyclicity (intransitivity) exists in the preferences of majority members. In such a situation, the group choice outcome via *majority rule* depends on a particular path by which pairwise votings are conducted – a phenomenon called *path dependency* of voting. Obviously, a chairperson who can choose which voting order to take can potentially manipulate the group's decision outcome to personal advantage (see Black, 1958, for further discussion of paradoxes of voting).

Although the preceding example is taken from a voting situation, manipulability accruing from a majority/plurality process may also play a substantive role in consensual decision making. For instance, Kameda (1991) demonstrated such a procedural manipulation in a situation where a group needs to consider several key conditions to render a final decision. An example might be investment decision making, in which several key criteria must be satisfied to make a final investment decision. Now, two contrasting discussion procedures are conceivable in these situations. In one procedure (*compound* procedure), the chairperson solicits members' overall conclusions from the outset. Analogous to the verdict-driven juries (Hastie et al., 1983), the chairperson encourages members to express their overall preferences – to invest or not. In contrast, the other procedure (*elemental* procedure) takes the opposite approach, focusing on collaborative evaluations of the key criteria. Somewhat analogous to the evidence-driven juries observed by Hastie and others, the chairperson asks for members' judgments of each of the conditions respectively (e.g., whether condition 1 is satisfied). Although these two procedures are both plausible and seemingly neutral, the choice of a procedure substantially impacts on the final group outcome, as illustrated in Table 14.2.

Table 14.2 displays a hypothetical opinion configuration of three members working on the investment decision task. Suppose that there are two key conditions to be satisfied to make the investment and that person A serves as the chairperson of this committee. As shown in Table 14.2, whereas member A prefers to invest, the other two members

Table 14.2. *An Illustrative Example of Group Decision Making Involving Several Conditional Judgments*

Member	Condition 1	Condition 2	Preference
A	Yes	Yes	Invest
B	Yes	No	Not invest
C	No	Yes	Not invest

do not. Therefore, provided that the consensual process is guided by a majority process, member A has little chance to prevail if the discussion centers on exchanging members' *preferences* (*compound procedure*). However, what if member A adopts the elemental procedure instead, stating, "To avoid a rough decision, why don't we examine each of the conditions carefully? Let's start with condition 1 . . . , etc." Assuming that each member is faithful to his or her original judgments, the same majority process should yield a positive collective judgment for each of the two criteria. Therefore, as the chairperson, member A can conclude the group discussion as follows: "We seem to have reached a conclusion after a careful deliberation. Both conditions for investment are satisfied" – the conclusion the chairperson prefers.

More formally, if the individual members' decision probabilities combine conjunctively, as in the preceding example, the binomial theorem (cf. Davis, 1973) yields the result that the probability of investment will *always* be higher with the elemental procedure than with the compound procedure. Specifically, in this example, the elemental procedure can theoretically increase the probability of the "investment" decision by the maximum margin of .13 for a 3-person group, .23 for a 6-person group, and .37 for a 12-person group compared to the compound procedure. Thus, the elemental procedure is more advantageous to the chairperson if this person desires to invest; if he or she prefers not to invest, the compound procedure should serve the chair's interest. Using four- and six-person groups, Kameda (1991) confirmed that consensus outcomes can be manipulated procedurally, as just discussed. Even when a group was instructed explicitly to discuss the issue until they reached a *unanimous* agreement (i.e., majority voting was thus discouraged), the two procedures affected consensus outcomes, as implied by the binomial model. Furthermore, no members were aware of the manipulation; group outcomes were essentially accepted as fair and satisfactory (cf. Lind & Tyler, 1988).

As illustrated in this example, the functioning of a majority/plurality process makes the *paradox of voting* a central issue to consensual decision making that lacks an explicit formal voting procedure. In a similar vein, continuous group decisions can also be guided toward a particular individual's personal advantage through procedural manipulation utilizing social sharedness tactically. Although space does not allow us to discuss them here, various forms of such procedural influences have been studied in the small group decision-making literature, including effects of sequential straw polling (Davis, Stasson, Ono, & Zimmerman, 1988), local majorities (Davis et al., 1989; Kameda & Sugimori, 1995), consensus rules (Davis, Kerr, Atkin, Holt, & Meek, 1975; Miller, 1989), agenda setting (Stasson, Kameda, & Davis, 1997), and so on. (See Davis, Hulbert, & Au, 1996, and Kameda, 1996, for further discussion on procedural influence on consensual decision making.)

Aggregation at the Cognitive Level

One of the main reasons groups are often perceived to be superior to individuals in terms of decision quality or accuracy is that groups bring more cognitive resources to the particular decision task (Tindale & Davis, 1983). Each member's knowledge, expertise, past experiences, and so on can be added to the whole and applied to the evaluation of the problem or decision at hand. Indeed, such a view provides a major justification for *consensual* decision making, expecting that important cognitive components can be brought in or newly shared among group members through face-to-face dialogue. However, like earlier research on problem solving (cf. Davis, 1969), more recent research specifically looking at information processing in groups has shown that groups do *not* necessarily harness these cognitive resources in an optimal way (Stasser & Titus, 1985). As we will see in this section, such suboptimal information processing in groups is often brought by *social sharedness* at the cognitive level. In a recent review article, Hinsz, Tindale, and Vollrath (1997) view information processing in groups as "the degree to which information, ideas, or cognitive processes are *shared*, and are *being shared*, among the group members . . ." (p. 43; italics added). In line with this view, we argue that the degree of social sharedness at the cognitive level is another central factor for understanding consensual decision making and is both consistent with, but different from, the aggregation processes at the preference level.

The Hidden Profile Approach

Although much of the early work on group decision making focused mainly on preferences, there were some exceptions (Graesser, 1982; Vinokur & Burnstein, 1974). Vinokur and Burnstein's work on Persuasive Arguments Theory was an attempt to explain group polarization at the information level. They argued that group members shifted their opinions in the direction of the majority (or, more accurately, in the direction of the dominant pole of the dimension) because group discussion generated novel and more persuasive arguments favoring the dominant pole (typically risk or caution on the items used). Thus, according to their theory, unique or unshared information was of central importance. Information that was shared by all group members would have little if any impact when brought up during discussion because everyone already knew it. Novel information, because it was unshared, would influence the preferences of the group members and subsequently, the final group choice.

However, more recent research has demonstrated exactly the opposite. Stasser and Titus (1985) designed a paradigm for studying the effects of shared and unshared information on group decision making that had a major impact on the field of small group research. The paradigm is referred to as the *hidden profile* approach, and the basic finding has been called the *common knowledge effect* (Gigone & Hastie, 1996). Stasser and Titus had four-person groups choose one of three political candidates based on information profiles about the candidates. However, in some of the conditions, different group members got different information. For one of the candidates (e.g., Candidate B), all four group members received all of the positive information about that candidate but only part of the negative information. For a different candidate (e.g., Candidate A), they received all of the negative information but only part of the positive information. Given the total pool of information, most people would have perceived Candidate A as best among the three. However, the superiority of Candidate A was *hidden* from particular group members because of the way in which the information was distributed. If group members shared all of the information available to them, they should have been able to see that Candidate A was superior. However, in the condition just described, most of the groups chose Candidate B. Given the way the information was distributed among the group members, most of the members' individual preferences were for B. Therefore, at the preference level, most groups had a majority for B and subsequently chose B.

Even though, at the time, this was a rather surprising finding, Stasser (1988) argued that two rather simple processes can account for this effect. First, research has shown that the likelihood of a piece of information being recalled by a group is a function of the number of members presented with that information (Hinsz, 1990; Tindale & Sheffey, 1992). Thus, shared information is more likely to be recalled than unshared information at the group level. In addition, even with perfect recall, the probability that a piece of information gets brought up is also a function of the number of members who have it. Based on these assumptions, Stasser and Titus (1987) formulated their Information Sampling Model to explain the common knowledge effect found in their hidden profile studies. The model (similar in structure to Lorge and Solomon's 1955 Model A for predicting correct problem solutions by groups) basically assumes that the probability, $p(D)$, that a given piece of information will be discussed is 1 minus the probability that no one mentions the item during discussion. Making simplified assumptions about independence, and so on, this notion may be written as

$$p(D) = 1 - [1 - p(M)]^n$$

where $p(M)$ is the probability of any given individual's mentioning a given item and n is the number of members having that item. When only one member knows a given piece of information, $p(D) = p(M)$. However, as n increases, so does $p(D)$, so that shared information is always more likely to be brought up during group discussion than unshared information. Larson, Foster-Fishman, and Keys (1994) showed that as discussion time increases, the likelihood of unshared information being brought up relative to shared information also increases. However, groups may easily reach a consensus (due to majority processes) before all the available information can be mentioned.

Although the common knowledge effect is fairly robust and has been replicated a number of times, there are some procedural mechanisms, common to consensus-seeking discussions, that can attenuate the effect. For example, both Sawyer (1997) and Sheffey, Tindale, and Scott (1989) have shown that allowing group members to keep a record of the information presented to them reduces, but does not eliminate, the effect. Sawyer also found that instructing group members not to form a priori judgments helps to reduce the effect, although this has not always been found to be effective (Sheffey et al., 1989). Also, Stasser and Stewart (1992) found that framing the task as a problem to be solved (implying a correct answer) led to greater sharing of unshared information during discussion. Finally, Stewart and Stasser (1995) demonstrated that assigning roles associated with the information distribution (e.g., "you are the expert on candidate X") led to more discussion of unshared information, but only when the roles were known by all of the group members.

Decomposing the Common Knowledge Effect

Much of the work just described used decision tasks with discrete decision alternatives and assessed the effects of shared and unshared information by looking at the group's response distributions and how much shared and unshared information was brought up during discussion. Although informative, such measures do not explicitly assess how the information was used, nor do they measure the potential importance of each type of information for both individual and group decisions. Using a different type of decision task, Gigone and Hastie (1993, 1996) attempted to address both of these issues and to explicate further the processes underlying the common knowledge effect. Their work is based on the Brunswik (1956) *lens model* approach to judgment, as developed within the context of Social Judgment Theory (SJT; Brehmer & Joyce, 1988; Hammond, Stewart, Brehmer, & Steinmann, 1986). The lens model describes the judgment process as a mapping of cues to a criterion using a weighted linear function, where the actual cue weights in the environment can be used to assess the viability of the mental model that a particular judge uses to predict the criterion. Gigone and Hastie generalized these ideas to a group judgment situation where different group members may have access to different cues. The full model defines the group judgments as a linear function of (a) a weighted average of members' preferences (where members' preferences are seen as a representation of a linear combination of the cues using weights specific to a particular member), (b) a weighted linear combination of the cues at the group level, (c) a weighted linear combination of whether each cue was pooled (discussed), and (d) an interaction term involving each cue and whether it was pooled, which represents the extent to which the weight for a particular cue depends on whether the cue is pooled (see Gigone & Hastie, 1996, for a more detailed description of the model).

Gigone and Hastie (1993) had groups of three students make 32 judgments about students' grades in an introductory psychology class based on six cues. Each cue was provided to either one, two, or all three group members. As predicted from the common knowledge effect, cues were more important (received greater weight) for the group judgments when they were presented to more group members. Although there were some inconsistencies, the relationship between cue weight and number of group members having access to the cue tended to be linear, particularly for cues that were considered important. Also, the probability that a cue was pooled increased as a function of the number of members having access to the cue. However, two rather interesting findings also emerged. First, the interaction term (cue by pooling) did not add significantly to the model. Second, when the full model was tested, the only term that added significantly to predicting the group judgments was the members' preferences. Thus, their results seem to indicate that the distribution of information in the group impacts the group judgment only indirectly through its effects on the members' preferences. Although more recent research has shown that the pooling of unshared information potentially may add to group judgment accuracy over and above members' preferences in some circumstances (Winquist & Larson, 1998), the Gigone–Hastie findings are quite consistent with the majority/plurality models discussed in the previous section. The degree to which information is shared impacts on information pooling during discussion, but it also impacts the member preference distribution. If the information is distributed in such a way as to produce a majority/plurality favoring a less than optimal decision alternative (as the hidden profile procedure does), then it is highly likely that groups will fail to reach a consensus on the optimal alternative. Thus, social sharedness at the cognitive level leads to a shared preference structure that ultimately drives the consensus process.

Shared Task Representations and Cognitive Centrality

The research on the common knowledge effect tends to show that shared cognitions play a central role in group decision making. In addition, it shows that shared cognitions and shared preferences tend to correspond with one another. However, two recent lines of research have shown that this correspondence is not necessary for shared cognitions to impact on group decisions. The first of these is based on the notion of a *shared task representation* (Tindale, Smith, Thomas, Filkins, & Sheffey, 1996) and stems conceptually from earlier work by Laughlin (1980; Laughlin & Ellis, 1986) on group problem solving. In contrast to judgmental tasks where no demonstrably correct solution exists, Laughlin has shown that, for tasks where the correctness of an alternative can be demonstrated, a minority faction favoring a demonstrably correct solution will tend to win out over an incorrect majority. In defining *demonstrability*, Laughlin and Ellis (1986) argued that a key feature is a system of axioms or beliefs that are shared among the group members. This shared belief system serves as a background for the members understanding the logic behind the correctness of a given alternative. Thus, using the shared belief system, minority factions arguing for a correct alternative can win out over majorities favoring an incorrect alternative.

Tindale et al. (1996) generalized this notion and argued that whenever a shared task representation exists, alternatives consistent with the representation will be easier to defend, and thus will be more likely to end up as the group's collective choice. Accordingly, the task representation that is shared does not have to support axiomatic "correctness" and may even be inconsistent with normatively correct positions. For example, mock juries given the "reasonable doubt" instruction tend to show asymmetries in the SDS models that best describe preference aggregation (MacCoun & Kerr, 1988; Tindale, Davis, Vollrath, Nagao, & Hinsz, 1990). Research has consistently demonstrated that both majorities and minorities favoring a "not guilty" verdict (which is consistent with the reasonable doubt processing objective given to the jury) are more powerful than majorities and minorities favoring a "guilty" verdict. In addition, incorrect representations, such as faulty decision strategies that most people use (Kahneman et al., 1982), can lead minorities favoring normatively incorrect alternatives to win out over majorities favoring normatively correct positions (Tindale, 1993; Tindale et al., 1996).

Recent research has shown that shared representations potentially operate in two different ways to affect group decisions. First, Smith, Tindale, and Steiner (1998), using a sunk cost problem, found that sunk cost arguments were persuasive, even if brought up by only a minority of members. Thus, arguments that are consistent with the shared representation can be especially influential in a group decision context. Second, a recent study by Tindale, Anderson, Smith, Steiner, and Filkins (1998), continuing a program of research looking at the estimation of conjunctive probabilities by individuals and groups (Tindale, Sheffey, & Filkins, 1990; Tindale, Filkins, Thomas, & Smith, 1993), videotaped the group discussions for conjunctive probability problems. Earlier research had shown that minorities making nonnormative estimates were more powerful than majorities making normative estimates. The videotaped group discussions showed that groups rarely discussed strategies concerning how to make the estimates, but rather simply exchanged information concerning their individual judgments. Quite often (more than 60% of the time), groups went with a single member's judgment. In those conditions where individuals were likely to make nonnormative estimates, groups were even more likely to do so, regardless of the preference distribution in the group. Thus, it seems that shared task representations can impact group decisions even when only preference information is exchanged. As long as a given individual preference is plausible within the shared representation, the group members will find it acceptable without thorough debate.

Virtually all of the aforementioned research has focused on the impacts of shared *cognitions* or *knowledge* per se on consensus. Little emphasis has been placed on group *members' status* or *power* as a function of degree of knowledge sharing with other members. For example, one member may share a substantial amount of information with other members, whereas another member may share only a portion of it. Because shared information has a greater impact on final group decisions, it seems likely that members having more shared information may acquire pivotal power in the group. This idea was tested in a recent set of studies by Kameda, Ohtsubo, and Takezawa (1997). Using a social network framework, Kameda et al. formulated a model to represent the degree to which any given member was "cognitively central" in the group. Much like Davis's (1996) SJS model, which locates members' preference centrality, Kameda et al.'s measure of *cognitive centrality* defines members in terms of their degree of centrality in the *sociocognitive network*. The greater the degree of overlap between the information held by a given member and the information held by other members on average, the greater the degree of centrality for that member.

Kameda et al. (1997) ran two studies to assess whether cognitively more central members would be more influential in their groups, regardless of their preference status (i.e., whether they were in minority or majority factions). In Study 1, they had three-person groups discuss whether a defendant in a highly publicized trial deserved the death penalty. By coding the contents of knowledge each member held prior to the group interaction, they calculated a cognitive centrality score for each member in each group. They then used the members' cognitive centrality scores to predict participation rates and opinion change after group discussion. Members' rankings in terms of centrality were positively related to their rankings in terms of participation. For members in minority factions, their degree of centrality also predicted (inversely) their amount of opinion change, though centrality was unrelated to opinion change for majority members.

In Study 2, Kameda et al. manipulated the information given to each group member to create two different situations. In one condition, the most cognitively central member of the group was a lone minority (in terms of preference) against a two-person majority. In the other condition, the most cognitively central person was part of the two-person majority, with the minority member being the least cognitively central. When the minority person was most cognitively central, the group went with the minority position (over the majority position) 67% of the time. When the minority person was least cognitively central, the minority won only 42% of the time. In addition, groups were considerably more confident in the conditions in which the central minority person's preference was chosen by the group. Thus, being the most cognitively central person in the group allows that person a greater degree of influence, even when holding a minority position in terms of preference. Kameda et al. (1997) argue that such enhanced social power accrues from perceptions of expertise for the cognitively central member in the focal knowledge domain.

Robust Influence of Social Sharedness: Some Suggestions for Future Research

In this chapter, we have examined representative theories and empirical findings about group decision making by focusing on the dual meanings of consensus – aggregation at the preference level and aggregation at the cognitive level. It seems clear that there is a marked similarity between the two levels of social aggregation. On both levels, social sharedness, the degree to which preferences and cognitions are shared among members prior to group interaction (cf. Tindale & Kameda, 2000), plays a vital function in determining consensus processes and outcomes. To recapitulate, a majority/plurality process (or an SJS-like process in a continuous judgment) essentially underlies the *preference*-level aggregation, especially when axiomatic (logical) or empirical correctness is difficult to establish. As side effects, these social processes make group decisions more polarized than individual decisions statistically and also make them vulnerable to arbitrary procedural manipulation. On the *cognitive* level, shared information or knowledge plays critical roles in guiding consensus. Shared information tends to be attended to more thoroughly than unshared information during group discussion, and indirectly impacts the final consensus via members' initial preferences. Persuasiveness of arguments or credibility of a member in a given task domain is also critically affected by shared knowledge.

Research on each level of aggregation, taken together, points to the general group phenomenon that *initial sharedness* of knowledge prepares the ground for consensus while severely constraining *shareability of knowledge* among members, viz., what type of knowledge can be newly shared by whom through communication. Somewhat analogous to Thomas Kuhn's notion of *paradigm* (Kuhn, 1962), such a cyclical process in group communication constitutes a *closed loop*.

Given the fundamental influence of social sharedness in consensual decision making, several directions for future research may be suggested along this line. One important direction, both theoretically and practically, may be to specify the ways for consensus groups to exit from the aforementioned closed loop. Recent work by Stasser and his colleagues (e.g., Wittenbaum, Vaughan, & Stasser, 1998) aims to address this issue by focusing on tacit task coordination among members. For example, if members are mutually aware of respective expertise in a group, exchange of unshared information (e.g., unique knowledge relevant to each member's expertise) should be facilitated, which may provide one way out of the closed loop (Stewart & Stasser, 1995). In fact, Kameda et al.'s (1997) notion of cognitive centrality may explain one way that such *meta-knowledge* (knowledge about the locus of knowledge – who knows what, whose knowledge is most reliable, etc.) emerges in a group *voluntarily*. Needless to say, disentangling the closed loop theoretically and finding various ways out constitutes an important research agenda toward effective group performance – a shared concern across various social science disciplines. Such a perspective also seems to provide a useful guideline for engineering research that aims to develop various *groupwares* implemented on computer systems (e.g., Smith, 1994).

Another important research direction may be to clarify how social sharedness at the preference and cognitive levels interplays in consensus processes. For example, when do they differ, and if they do, which level takes precedence and why? Factors associated with a context/situation in which a group decision is sought may be critical in answering such questions. Time pressure, for example, would probably lead to focusing on social sharedness at the preference level at the expense of the cognitive level (cf. Hinsz et al., 1997). The SJT paradigm developed by Gigone and Hastie (1993, 1996) also seems to be useful in exploring these issues. However, at this point, many related interesting questions are still open, awaiting future empirical investigations.

Potentially the most important line of research relating to social sharedness concerns *why* it is such a powerful force in group decision making. For example, majorities may contain only one more member than a competing minority, yet they define the group consensus nearly 100% of the time. Thus, their power is often far greater than their relative numbers. In addition, shared information not only gets brought up more often, but also is weighted more heavily in the final group judgment (Gigone & Hastie, 1996). Thus, the power of social sharedness at the cognitive level is not just a function of the greater probability of shared information being brought up. Although this topic has received little attention to date, recent theory and research on the *social nature of reality* (cf. Hardin & Higgins, 1996) may provide a useful framework for understanding the power of social sharedness. Knowing that one shares preferences with the largest faction within a group may instill greater confidence in the correctness of one's position, and hearing that others share information you already have may help to establish socially the validity of the information.

With a similar goal, it seems worthwhile to examine the degree of *net efficiencies* that various types of social influences, as discussed in this chapter, may achieve in group decision making. For example, intrigued by the recent adaptive decision-making arguments (e.g., Fiedler, 1996; Gigerenzer & Goldstein, 1996; Payne, Bettman, & Johnson, 1993), Kameda and Hastie (1999) explored the accuracy of various *group decision heuristics* (i.e., commonly used aggregation methods) under uncertainty by a series of Monte Carlo computer simulations. These researchers found that a simple majority/plurality aggregation, albeit being fairly cheap in terms of necessary social/cognitive calculation costs, achieves an accuracy level essentially comparable to that of much more effortful aggregation algorithms (see also Sorkin, Hays, & West, 2001; Sorkin, West, & Robinson, 1998). Such a finding may explain why majority/plurality aggregation is so robust in group decision making, as reviewed in this chapter. Given the increased focus on adaptive aspects of human decision making, examining various functions of social sharedness in guiding consensus from an adaptive perspective seems theoretically quite promising (cf. Kameda & Nakanishi, 2002).

As we have discussed in this chapter, social sharedness plays a fundamental role in consensual decision making that features face-to-face interaction (e.g., the committee). We believe that this notion serves as a useful common thread for understanding various features of group decision making and also generates many intriguing questions for future research endeavors.

References

Arrow, K. J. (1963). *Social choice and individual values* (2nd ed.). New Haven, CT: Yale University Press.

Black, D. (1958). *The theory of committees and elections.* Cambridge: Cambridge University Press.

Brehmer, B., & Joyce, C. R. B. (Eds.). (1988). *Advances in psychology: Vol. 4. Human judgment: The SJT view.* North Holland: Elsevier.

Brunswik, E. (1956). *Perception and the representative design of psychological experiments*. Berkeley: University of California Press.

Coleman, J. S. (1990). *Foundations of social theory*. Cambridge, MA: Harvard University Press.

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

Davis, J. H. (1973). 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* (Vol. 1, pp. 157–229). Hillsdale, NJ: Erlbaum.

Davis, J. H. (1982). Social interaction as a combinatorial process in group decision. In H. Brandstatter, J. H. Davis, & G. Stocker-Kreichgauer (Eds.), *Group decision making* (pp. 27–58). 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. 35–59). Mahwah, NJ: Erlbaum.

Davis, J. H., Au, W., Hulbert, L., Chen, X., & Zarnoth, P. (1997). Effect of group size and procedural influence on consensual judgment of quantity: The example of damage awards on mock civil juries. *Journal of Personality and Social Psychology, 73*, 703–718.

Davis, J. H., Hulbert, L., & Au, W. (1996). Procedural influence on group decision making: The case of straw polls – observation and simulation. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision making* (2nd ed., pp. 384–425). Beverly Hills, CA: Sage.

Davis, J. H., Kameda, T., Parks, C., Stasson, M., & Zimmerman, S. (1989). Some social mechanics of group decision making: The distribution of opinion, polling sequence, and implications for consensus. *Journal of Personality and Social Psychology, 57*, 1000–1014.

Davis, J. H., Kameda, T., & Stasson, M. (1992). Group risk taking: Selected topics. In F. Yates (Ed.), *Risk-taking behavior* (pp. 163–199). Chichester, U.K.: Wiley.

Davis, J. H., Kerr, N. L., Atkin, R. S., Holt, R., & Meek, D. (1975). The decision processes of 6- and 12-person mock juries assigned unanimous and two-thirds majority rules. *Journal of Personality and Social Psychology, 32*, 1–14.

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

Davis, J. H., Stasson, M., Ono, K., & Zimmerman, S. K. (1988). The effects of straw polls on group decision making: Sequential voting pattern, timing, and local majorities. *Journal of Personality and Social Psychology, 55*, 918–926.

Fiedler, K. (1996). Explaining and simulating judgment biases as an aggregation phenomenon in probabilistic, multiple-cue environments. *Psychological Review, 103*, 193–214.

Fishburn, P. (1973). *The theory of social choice*. Princeton, NJ: Princeton University Press.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103*, 650–669.

Gigone, D., & Hastie, R. (1993). The common knowledge effect: Information sharing and group judgment. *Journal of Personality and Social Psychology, 65*, 959–974.

Gigone, D., & Hastie, R. (1996). The impact of information on group judgment: A model and computer simulation. In E. Witte & J. H. Davis (Eds.), *Understanding group behavior: Consensual action by small groups* (Vol. 1, pp. 221–251). Mahwah, NJ: Erlbaum.

Graesser, C. C. (1982). A social averaging theorem for group decision making. In N. H. Anderson (Ed.), *Contributions of information integration theory* (Vol. 2, pp. 1–40). New York: Academic Press.

Hammond, K. R., Stewart, T. R., Brehmer, B, & Steinmann, D. (1986). Social judgment theory. In H. R. Arkes & K. R. Hammond (Eds.), *Judgment and decision making: An interdisciplinary reader* (pp. 56–76). New York: Cambridge University Press.

Hardin, C. D., & Higgins, E. T. (1996). Shared reality: How social verification makes the subjective objective. In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition: The interpersonal context* (Vol. 3, pp. 28–84). New York: Guilford Press.

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

Hinsz, V. B. (1990). Cognitive and consensus processes in group recognition memory performance. *Journal of Personality and Social Psychology, 59*, 705–718.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conception of groups as information processors. *Psychological Bulletin, 121*, 43–64.

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

Kameda, T. (1991). Procedural influence in small-group decision making: Deliberation style and assigned decision rule. *Journal of Personality and Social Psychology, 61*, 245–256.

Kameda, T. (1996). Procedural influence in consensus formation: Evaluating group decision making from a social choice perspective. In E. Witte & J. H. Davis (Eds.), *Understanding group behavior: Consensual action by small groups* (Vol. 1, pp. 137–161), Mahwah, NJ: Erlbaum.

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.

Kameda, T., & Hastie, R. (1999). *Social sharedness and adaptation: Adaptive group decision heuristics*. Paper presented at the 17th Subjective Probability, Utility, and Decision Making Conference, Mannheim, Germany.

Kameda, T., & Nakanishi, D. (2002). Cost-benefit analysis of social/cultural learning in a non-stationary uncertain environment: An evolutionary simulation and an experiment with human subjects. *Evolution and Human Behavior, 23*, 373–393.

Kameda, T., Ohtsubo, Y., & Takezawa, M. (1997). Centrality in socio-cognitive network and social influence: An illustration in a group decision making context. *Journal of Personality and Social Psychology, 73*, 296–309.

Kameda, T., & Sugimori, S. (1993). Psychological entrapment in group decision-making: An assigned decision rule and a groupthink phenomenon. *Journal of Personality and Social Psychology, 65*, 282–292.

Kameda, T., & Sugimori, S. (1995). Procedural influence in two-step group decision making: Power of local majorities in consensus formation. *Journal of Personality and Social Psychology, 69,* 865–876.

Kerr, N. L., MacCoun, R. J., & Kramer, G. P. (1996). Bias in judgment: Comparing individuals and groups. *Psychological Review, 103,* 687–719.

Kerr, N. L., Stasser, G., & Davis, J. H. (1979). Model testing, model fitting, and social decision schemes. *Organizational Behavior and Human Performance, 23,* 399–410.

Kuhn, T. (1962). *The structure of scientific revolutions.* Chicago: University of Chicago Press.

Lamm, H., & Myers, D. G. (1978). Group induced polarization of attitudes and behavior. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 11, pp. 145–195). New York: Academic Press.

Larson, J. R., Jr., Foster-Fishman, P. G., & Keys, C. B. (1994). Discussion of shared and unshared information in decision-making groups. *Journal of Personality and Social Psychology, 67,* 446–461.

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

Laughlin, P. R., & Ellis, A. L. (1986). Demonstrability and social combination processes on mathematical intellective tasks. *Journal of Experimental Social Psychology, 22,* 177–189.

Lind, A. E., & Tyler, T. R. (1988). *The social psychology of procedural justice.* New York: Plenum Press.

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

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

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

Mueller, D. C. (1989). *Public choice II.* New York: Cambridge University Press.

Ordeshook, P. C. (1986). *Game theory and political theory.* New York: Cambridge University Press.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker.* Cambridge: Cambridge University Press.

Sanders, G. S., & Baron, R. S. (1977). Is social comparison irrelevant for producing choice shift? *Journal of Experimental Social Psychology, 13,* 303–314.

Sawyer, J. E. (1997). *Information sharing and integration in multifunctional decision-making groups.* Paper presented at the annual meeting of the Society of Judgment and Decision Making, Philadelphia.

Sen, A. (1977). Social choice theory: A re-examination. *Econometrica, 45,* 53–89.

Sheffey, S., Tindale, R. S., & Scott, L. A. (1989). *Information sharing and group decision-making.* Paper presented at the annual convention of the Midwestern Psychological Association, Chicago.

Smith, C. M., Tindale, R. S., & Steiner, L. (1998). Investment decisions by individual and groups in "sunk cost" situations: The potential impact of shared representations. *Group Processes and Intergroup Relations, 2,* 175–189.

Smith, J. B. (1994). *Collective intelligence in computer-based collaboration.* Hillsdale, NJ: Erlbaum.

Sorkin, R. D., Hays, C., & West, R. (2001). Signal-detection analysis of group decision making. *Psychological Review, 108,* 183–203.

Sorkin, R. D., West, R., & Robinson, D. E. (1998). Group performance depends on the majority rule. *Psychological Science, 9,* 456–463.

Stasser, G. (1988). Computer simulation as a research tool: The DISCUSS model of group decision making. *Journal of Experimental Social Psychology, 24,* 393–422.

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., pp. 279–326). Hillsdale, NJ: Erlbaum.

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

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

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

Stasson, M., Kameda, T., & Davis, J. H. (1997). A model of agenda influences on group decisions. *Group Dynamics, 1,* 316–323.

Stewart, D. D., & Stasser, G. (1995). Expert role assignment and information sampling during collective recall and decision making. *Journal of Personality and Social Psychology, 69,* 619–628.

Tindale, R. S. (1989). Group vs. individual information processing: The effects of outcome feedback on decision-making. *Organizational Behavior and Human Decision Processes, 44,* 454–473.

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

Tindale, R. S., Anderson, E. M., Smith, C. M., Steiner, L., & Filkins, J. (1998). *Further explorations of conjunction errors by individuals and groups.* Paper presented at the British Psychological Society Social Psychology Section Conference, Canterbury, UK.

Tindale, R. S., & Davis, J. H. (1983). Group decision making and jury verdicts. In H. H. Blumberg, A. P. Hare, V. Kent, & M. F. Davies (Eds.), *Small groups and social interaction* (Vol. 2, pp. 9–38). Chichester, U.K.: Wiley.

Tindale, R. S., & Davis, J. H. (1985). Individual and group reward allocation decisions in two situational contexts: The effects of relative need and performance. *Journal of Personality and Social Psychology, 48,* 1148–1161.

Tindale, R. S., Davis, J. H., Vollrath, D. A., Nagao, D. H., & Hinsz, V. B. (1990). Asymmetrical social influence in freely interacting groups: A test of three models. *Journal of Personality and Social Psychology, 58,* 438–449.

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

Tindale, R. S., & Kameda, T. (2000). "Social sharedness" as a unifying theme for information processing in groups. *Group Processes and Intergroup Relations, 3*, 123–140.

Tindale, R. S., & Sheffey, S. (1992). *Optimal task assignment and group memory*. Paper presented at the Nags Head Conference on Groups, Networks, and Organizations, Highland Beach, FL.

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

Tindale, R. S., Smith, C. M., Thomas, L. S., Filkins, J., & Sheffey, S. (1996). Shared representations and asymmetric social influence processes in small groups. In E. Witte & J. H. Davis (Eds.), *Understanding group behavior: Consensual action by small groups* (Vol. 1, pp. 81–103). Mahwah, NJ: Erlbaum.

Vinokur, A., & Burnstein, E. (1974). The effects of partially shared persuasive arguments on group induced shifts: A group problem solving approach. *Journal of Personality and Social Psychology, 29*, 305–315.

Winquist, J. R., & Larson, J. R. (1998). Information pooling: When it impacts group decision making. *Journal of Personality and Social Psychology, 74*, 371–377.

Witte, E., & Davis, J. H. (Eds.). (1996). *Understanding group behavior: Consensual action by small groups* (Vol. 1). Mahwah, NJ: Erlbaum.

Wittenbaum, G. M., Vaughan, S. I., & Stasser, G. (1998). Coordination in task-performing groups. In R. S. Tindale, J. Edwards, F. B. Bryant, & E. J. Posavac (Eds.), *Social psychological applications to social issues: Vol. 4. Applications of theory and research on groups* (pp. 177–204). New York: Plenum Press.