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GROUP PERFORMANCE AND DECISION MAKING

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■ **Abstract** Theory and research on small group performance and decision making is reviewed. Recent trends in group performance research have found that process gains as well as losses are possible, and both are frequently explained by situational and procedural contexts that differentially affect motivation and resource coordination. Research has continued on classic topics (e.g., brainstorming, group goal setting, stress, and group performance) and relatively new areas (e.g., collective induction). Group decision making research has focused on preference combination for continuous response distributions and group information processing. New approaches (e.g., group-level signal detection) and traditional topics (e.g., groupthink) are discussed. New directions, such as nonlinear dynamic systems, evolutionary adaptation, and technological advances, should keep small group research vigorous well into the future.

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INTRODUCTION

Many *Annual Review* chapters begin like acts of confession—Father/reader, it has been one week/five years since my/the last confession/review of this literature. In the present case, it has been more than a dozen years since the topics of this chapter—group performance and decision making—were last surveyed in the pages of the *Annual Review of Psychology* by Levine & Moreland (1990). As in most confessions, we have omitted many fascinating matters and many of the omissions are intentional. The latter include several of the group-relevant topics that were also omitted in Levine & Moreland's chapter—large group (e.g., crowd, mob, organizational) behavior (see Wilpert 1995, Bond & Smith 1996); intergroup relations (see Hewstone et al. 2002, Pettigrew 1998); special types of groups (e.g., therapy groups, children's groups)—as well as a few of the topics that they did cover—viz. group structure, group composition, and conflict in groups. With respect to the latter topic, we are interested in one aspect of conflict within groups—how group members resolve opinion or preference conflicts in consensus-seeking groups—but are not concerned with several other related aspects, such as conflict arising from interdependence among group members (e.g., as in social dilemmas, bargaining, negotiation, and coalition formation; see recent reviews of several of these topics by Komorita & Parks 1995, Carnevale & Pruitt 1992, Bazerman et al. 2000) or general processes of social influence (cf. Wood 2000).

We also largely omit coverage of two other topics—leadership and team performance. Work on these topics has been (or soon will be) reviewed in *Annual Review* chapters (e.g., Chemers 2000; Goethals, manuscript in preparation; Guzzo & Dickson 1996). The distinction between performance teams (the focus of the latter review) and performance groups (the focus of the present review) is, we confess, a fuzzy one. Team research tends to focus on relatively longer-term groups with multiple task responsibilities, often functioning within an organization. Team research tends to have a relatively applied research focus and to be conducted in more applied subdisciplines (e.g., I/O psychology, management). Small group performance research, on the other hand, tends to be basic research conducted by social psychologists, and is usually studied experimentally in ad-hoc laboratory groups. However, there are many exceptions to these general rules. In our judgment, the distinction is a rather artificial one that reflects more about subdisciplinary territoriality than about fundamental differences in focus or objectives. We offer the present review both to summarize the past dozen years' activity on the "small groups" side of the border (with occasional glimpses of work that spans the border) and to contribute to more intellectual border traffic.

We focus on groups performing tasks and/or making decisions. Our primary interest is in the group's output or product (e.g., solution, decision) and the processes whereby the group achieves that product. The chapter has two main sections. The

first focuses on recent research (defined here as appearing since 1989, the period following Levine & Moreland's review) on group performance at a variety of response-creation or response-sequencing tasks, including production, problem-solving, and creativity tasks. The second section focuses on the topic of group decision making, i.e., collective response selection. Much of the work in these areas has been focused on a particular topic, question, or contrast. In our review, we concentrate on those topics which have received sustained research attention and/or on which some tangible progress has been made.

GROUP PERFORMANCE

Group Process Losses and Gains

Much of the work to be reviewed here explicitly or implicitly utilizes one or more baseline models that predict the group's product under certain process assumptions (Steiner 1972, Davis 1969). The best-known and most widely utilized example is Steiner's (1972) potential productivity baseline—the group's optimal level of performance under the assumption of some idealized coordination/combination of member resources. Absent some such baseline, it will often be difficult to meaningfully characterize whether groups are achieving, exceeding, or falling short of any reasonable expected level of performance. With such a baseline, one can test and refine one's theoretical assumptions.

The ubiquitous finding across many decades of research (e.g., see Steiner 1972, Hill 1982) is that groups usually fall short of reasonable potential productivity baselines—in Steiner's terminology, they exhibit process losses. The theoretical and empirical analyses of such process losses have shed considerable light on group dynamics. Some more recent work, though, has sought to identify informative exceptions to this rule—that is, to identify tasks and performance contexts in which groups might reach or even exceed their apparent potential. One such potential productivity baseline is the performance level of the group's most capable member. A few studies have reported performance groups attaining this criterion (Laughlin et al. 1995, 1998b, 2003). And, a very few studies (Laughlin et al. 2002, Michaelsen et al. 1989, Tindale & Sheffey 2002, Sniezek & Henry 1989) have reported the elusive process gain or "assembly bonus effect"—group performance that is better than the performance of any individual or any combination of individual member efforts. Such claims need to be examined very carefully. Such effects are usually modest, and it is easy to underestimate the potential of the group and consequently to overstate the group's level of achievement (cf. Tindale & Larson 1992a,b).

It may sometimes be hard for scholars to agree on just what a group's true potential is; it is far less difficult and probably ultimately more productive to document work conditions or interventions that improve group performance (and thus, help groups approach or possibly exceed any plausible potential productivity baseline). So, for example, giving group members task-relevant information that simplifies or reframes their task can enhance group performance (Laughlin et al.

1999, 2003). Several recent meta-analyses indicate that more cohesive groups (and their individual members) tend generally to be more productive (Evans & Dion 1991, Gully et al. 1995, Mullen & Copper 1994, Oliver et al. 1999), although it appears that group norms must favor high productivity (Langfred 1998), group members must be committed to performance goals (Podsakoff et al. 1997), and task requirements further moderate the relationship (Craig & Kelly 1999, Zaccaro 1991). Moreover, at least part of the robust association between cohesiveness and group performance may stem from good performance enhancing the group's cohesiveness (Mullen & Copper 1994).

Because failure to identify and utilize the resources of capable group members is a clear source of group process loss, considerable useful work has been devoted to analyzing and assisting groups' efforts to identify their best members. At least for some tasks, groups can recognize member expertise (i.e., they can do better than chance; Henry 1993). Some of the cues that underlie perceived expertise have been identified (e.g., loquacity, use of reason to influence, member confidence and dominance; Littlepage & Mueller 1997, Littlepage et al. 1995). And some work conditions that improve groups' recognition of expertise have also been discovered (e.g., larger groups, Littlepage & Silbiger 1992; explicit instructions to share task information or to try to identify the most capable group member, Henry 1995, Henry et al. 2002; receiving regular performance outcome feedback, Henry et al. 1996; prior experience working together, Littlepage et al. 1997, Goodman & Shah 1992). Moreland and his colleagues (e.g., Moreland 1999, Moreland & Argote 2003) have analyzed the problem in terms of the creation of a transactive memory, mutual awareness of "who knows what." They have shown that one effective way to develop such transactive memory is by being trained as a group (e.g., Liang et al. 1995), where it appears to be the opportunity to learn about one another's competencies, and not other confounding aspects of group training (e.g., stronger group identification, better opportunities to communicate with one another, enhanced task motivation) that is crucial (Moreland & Myaskovsky 2000).

There has been growing interest in whether "electronic groups"—where intermember communication is managed electronically rather than in face-to-face interaction—might have certain performance advantages. Clearly, such groups permit more flexible (e.g., geographically distributed; nonsimultaneous) forms of intragroup communication, and (at least in principle) ready access to in- and out-group resources. In addition, electronic groups can foster stronger group identification (Lea et al. 2001) and adherence to group norms (Spears et al. 1990; although see Douglas & McGarty 2001). However, several studies show either no performance advantage for such electronic group performance settings (e.g., Straus & McGrath 1994) or some disadvantage, especially when the group's task requires close coordination of member efforts or members are unfamiliar with the electronic technology (Hollingshead et al. 1993, Straus & McGrath 1994). Likewise, giving group members access to electronic databases containing group member capability information has generally not boosted group effectiveness (Moreland 1999). One

striking exception to this generally disappointing picture is the facilitative effect of computerized brainstorming, to be discussed below.

Group Brainstorming

The productive use of potential productivity baselines is nicely illustrated by recent work on group brainstorming, a method of collective idea generation popularized by Osborn (1957). Such groups are instructed to generate as many ideas as possible, to avoid criticism of any ideas, and to strive to combine and improve on others' ideas. Both Osborn and most members of brainstorming groups (cf. Paulus et al. 1993) believe that such groups routinely outperform equal-sized sets of noninteracting individuals (the nominal group baseline). However, several decades of research have shown that nominal groups usually outperform such brainstorming groups (e.g., Mullen et al. 1991). Older (i.e., pre-1989) research indicated that this was, in large part, due to "production blocking"—the inability for more than one group member to talk (and, perhaps, think) at a time (Diehl & Stroebe 1987). More recent work has refined, extended, and challenged these conclusions.

The negative impact of production blocking seems not to stem from simple interference with memory or from the unpredictability of speaking turns (Diehl & Stroebe 1991). Rather, it appears that the usual melee of group discussion tends to interfere with our ability to get a productive train of thought started, or can effectively "derail" an ongoing train of thought (Nijstad 2000). Such work illustrates a broader shift of attention away from the suboptimality of performance groups and toward a distinctive and novel brand of "social cognition"—viz. the effects of group contexts upon cognition (Levine et al. 1993, Hinsz et al. 1997, Larson & Christensen 1993). In addition to production blocking, at least two other processes have been implicated in process loss in brainstorming groups: an unwillingness to contribute ideas because of evaluation apprehension, and a convergence via social comparison on a relatively low standard for performance in face-to-face groups (Camacho 1995, Larey & Paulus 1995, Paulus & Dzindolet 1993, Paulus et al. 1996, Roy et al. 1996).

Others have utilized this knowledge about the sources of process loss in brainstorming groups to develop improvements on traditional group brainstorming. For example, training a facilitator to minimize production blocking and evaluation apprehension can reduce or even eliminate the usually observed process loss (Offner et al. 1996, Oxley et al. 1996). Alternative framing of a problem can help prevent the "derailment" caused by production blocking in unstructured group discussion (e.g., sequential consideration of relevant subtasks) and improve group (and individual) performance (Coskun et al. 2000). Most noteworthy has been the work on electronic brainstorming where computer software allows isolated individuals to type in their ideas without interruption (i.e., no production blocking; Gallupe et al. 1994), to be anonymous (low evaluation apprehension; Cooper et al. 1998), and yet to be able to see copies of other group members' ideas on the screen whenever they like. Such computerized brainstorming groups have been found not only to

perform as well as nominal groups (e.g., Gallupe et al. 1991) but, when fairly large ($n > 9$), even to outperform them (Dennis & Valacich 1993, 1994; Valacich et al. 1994). The latter result seems not to stem from the relatively higher likelihood of very large groups coming up with rare, "off-the-wall" ideas (Connolly et al. 1993), but rather—in line with Osborne's original claims for group brainstorming—from the stimulating effect of exposure to others' ideas, a suggestion that (*a*) has been supported in several recent studies (Leggett-Dugosh et al. 2000, Nijstad et al. 2003, Paulus & Yang 2000; although also see Ziegler et al. 2000) and (*b*) all else being equal, encourages heterogeneity/diversity in idea-generating groups (Schruijer & Mostert 1997, Stroebe & Diehl 1994).

Group Motivation Losses and Gains

Levine & Moreland's (1990) review appeared after an active period of research that documented and explained reduced levels of motivation among members of task performing groups relative to comparable individual performers. Such effects have been referred to as group motivation losses (Steiner 1972) or as social loafing (Latané et al. 1979). Older research identified a number of distinct psychological mechanisms underlying such effects (e.g., reduced risks of evaluation; opportunities to free ride on other group members' efforts; and an unwillingness to do the work that a capable, free-riding partner could be doing) as well as a number of moderating variables (e.g., high task interest or involvement tends to attenuate these effects; B.N. Smith et al. 2001). More recent work has identified additional moderating variables, either through new original research or via meta-analysis. Karau & Williams' (1993) meta-analysis established, for example, that social loafing effects are stronger for males and for groups from Western cultures. Because such cultural differences are often attributed to stable differences in a more general individualist-collectivist personality disposition, it is not surprising that social loafing appears to be relatively stronger among individualists (Erez & Somech 1996, Wagner 1995) or those who see themselves as better than others (Charbonnier et al. 1998, Huguet et al. 1999). Social loafing is attenuated by high group cohesion (Everett et al. 1992, Karau & Hart 1998, Karau & Williams 1997, Worchel et al. 1998) or anticipated punishment for poor performance (Miles & Greenberg 1993). Likewise, conditions that increase the cost of effortful task performance (e.g., fatigue; Hoeksema van Orden et al. 1998, Anshel 1995) or reduce one's sense of responsibility to the group (Kerr & Stanfel 1993) tend to increase social loafing.

Paralleling this empirical work has been valuable theoretical work designed to integrate and organize this large literature. Several scholars (Karau & Williams 1993, Shepperd 1993) have independently argued that expectancy-value theories provide a useful theoretical framework. Such models also suggest that there may be group situations in which the instrumentality of one's task efforts and/or the value attached to effort-mediated outcomes might be higher than for comparable individual performers. This observation prompted a search for group motivation gains—where group members exert greater task effort than comparable individual

performers. At least two such phenomena have been demonstrated empirically. The first, social compensation, occurs when ". . .individuals increase their efforts on collective tasks to compensate for the anticipated poor performance of other group members" (Karau & Williams 1997, p. 158). These effects have been obtained (Williams & Karau 1991, Karau & Williams 1997, Hart et al. 2001) under conditions that much other research would suggest are ideal for inducing social loafing—conditions of low identifiability and high risk that one may have to shoulder an inequitably large share of the group's work. There is, though, one key difference—group success must be extremely important to the more capable group member. Loafing will occur if the group task is not very important (Williams & Karau 1991, Exp. 3). Given the strong opposing forces encouraging both reduced and enhanced effort, this phenomenon appears to be easily disrupted—e.g., by how partner effort is communicated (Hart et al. 2001, Williams & Karau 1991). It is observed with low-cohesiveness groups, but oddly, not with more highly cohesive groups (Karau & Williams 1997, Exp. 2). Clearly, more research is needed to establish the robustness and boundary conditions of the social compensation effect.

The other recently documented motivation gain effect is the Köhler effect. It occurs when less-capable members of groups working at conjunctive tasks (i.e., where the poorest performance defines the group score) increase their effort. After this effect's discovery in the 1920s (Köhler 1926), it was forgotten until fairly recently (Witte 1989). However, in the last decade, the overall motivation gain effect has been replicated several times (Hertel et al. 2000a,b, 2003), as has the moderating effect of member ability discrepancy—viz. lower gains for small or very large discrepancies in partner ability [originally observed by Köhler (1926)] (Messé et al. 2002; Stroebe et al. 1996, Exp. 1)—and of partner sex (Lount et al. 2000). The psychological causes of the effect have yet to be clearly established. There is some evidence that the indispensability of the less-capable member's contribution to the group's performance (or, to that member's evaluation within the group) is crucial (Hertel et al. 2000a, Exp. 2) and that the effect may be due (at least in part) to a social comparison process that either affects the goals members set (Stroebe et al. 1996) and/or induces intragroup competition (Stroebe et al. 1996, Exp. 2, 3). The latter possibility is bolstered by work demonstrating the potential of intergroup competition for enhancing group member task motivation (Erev et al. 1993).

Group Goal Setting

There has long been interest in the process and effects of group goal setting on both group performance and member attitudes (e.g., satisfaction). Much of this work (e.g., Yammarino & Naughton 1992, Durham et al. 1997, Johnson et al. 1997, Ludwig & Geller 1997) seeks to demonstrate that group performance, member performance, and/or member satisfaction are enhanced by collective agreement on a challenging goal (versus "do your best," self-set, assigned, or no-goal control

conditions). Generally, productivity and satisfaction do tend to be higher when groups collectively set challenging performance goals (O'Leary-Kelly et al. 1994, Wegge 2000); however, these facilitative effects are neither highly consistent nor very strong (Locke et al. 1997, Larey & Paulus 1995). Much of the recent work in this area has focused on exploring when and why group goal setting has its effects. For example, Latham et al. (1994) found that participative group goal setting (PGGS) can enhance performance via enhancing the group's task knowledge. Other work (Wegge & Kleinbeck 1996, Wegge 2000) implicates anxiety reduction as a key mediator of the PGGS-performance relationship. Another group-level construct, collective efficacy (Bandura 1997), mediates the goal setting–performance relationship (Prussia & Kinicki 1996); as shared feelings of capability increase in a group, groups tend to set higher goals for themselves and perform better. Elsewhere, Roberson et al. (1999) show that group members' sense of procedural fairness can mediate the PGGS-satisfaction relationship. Participative goal setting appears to be a complex process with several mediating mechanisms; it remains a theoretical and empirical challenge to provide a systematic and comprehensive account of this process (cf. Wegge 2000, Weldon & Weingart 1993). Work that explores the group goal-setting process itself (e.g., Hinsz 1991, 1992, 1995; Mesch et al. 1994) should contribute to such an account.

Stress and Group Performance

Groups are routinely called upon to perform under highly stressful conditions. A tempting, intuitive guess is that increasing stress (e.g., time pressure, poor work environments, complex tasks, etc.) would generally degrade group performance. The reality seems to be much more complex. The older literature on the effects of stress on individual performance (see Kaplan et al. 1993, or Karau & Kelly 1992, for reviews) suggested a number of regularities—stress tends to increase the performance quantity with an accompanying decline in quality, to narrow attention onto more vital task features, and to prompt more simplified, heuristic information processing. For the most part, these regularities have been replicated in both earlier (for reviews, see Brown & Miller 2000, and Kelly & Karau 1993) and more recent research on performance groups. Karau & Kelly (1992) and De Grada et al. (1999) show that increasing time pressure leads to greater task focus within performance groups. Within certain limits, groups seem able to adapt to higher levels of stress (Brown & Miller 2000, Hollenbeck et al. 1997, Volpe et al. 1996); however, if such stress grows sufficiently high, group performance will eventually be degraded (Adelman et al. 2003, Entin & Serfaty 1999, Urban et al. 1996). As the Yerkes-Dodson Law would suggest, sometimes increases in stress (from low to moderate levels) can actually enhance aspects of group performance (Karau & Kelly 1992). Attempts have also been made to both describe how performance groups allocate their limited resources (e.g., time; Littlepage & Poole 1993) and to identify ideal group performance strategies for combating the process losses arising from stressful working conditions (Haertel & Haertel 1997, Littlepage & Karau 1997).

Kelly and her colleagues have continued to build on their older work on the effects of one particular source of stress—time pressure—on collective performance. That older work (see Kelly 1988) suggested that the pace and quality of a group's work could be set or "entrained" by initial time limits on group performance. Hence, groups given lax initial time limits can be entrained to work slowly and carefully at a creativity task, so that if they are later required to work under stressful, stringent time limits, they will work more slowly but with higher quality than groups entrained under more stringent time limits (Kelly & Karau 1993). However, in other work (Kelly et al. 1990), it has been shown that this pattern depends upon how group members attribute any initial difficulty with the task.

A related, promising line of theory and research has been proposed by Kruglanski and his colleagues (e.g., Kruglanski et al. 2002). This research extends earlier work on the effects of "need for closure" (i.e., the desire for definite, nonambiguous solutions) among individuals to the group level. Kruglanski argues that stressful group work conditions tend to increase this need, which has a number of consequences for information exchange and utilization. Groups under stress should (and do; see Kruglanski et al. 1993) exhibit a stronger desire for uniformity of opinion/preference. Unless group members already have very strongly held preferences (in which case the "freezing" that is a common result of enhanced need for closure can lead to a reduced readiness to yield to others), such uniformity can be achieved through stronger attempts to influence opinion deviates and/or a greater readiness to yield to others. Both processes should encourage centralization of power/influence in a few influential group members (e.g., leaders), manifest by greater conversational and power asymmetry in the group (De Grada et al. 1999) and communication patterns centralized on the more powerful members (Pierro et al. 2003; although see Brown & Miller 2000). Once a clear group position or solution has been achieved, a heightened need for closure also should (and does; see Kruglanski & Webster 1991) prompt (*a*) stronger tendencies for group members to support that position, and (*b*) pressures to accept those that conform and reject those that deviate from that position. In summary, Kruglanski has shown that stressful conditions tend to result in a "closing of the group mind"—an aversion to unpopular options, an acceptance of autocratic leadership and extant group norms. The validity of these arguments is bolstered by empirical demonstrations of similar effects due to varying need for closure in groups via group composition (De Grada et al. 1999, Kruglanski & Webster 1991).

Collective Induction

Laughlin and his colleagues (e.g., Laughlin 1996, 1999; Laughlin & Hollingshead 1995) have undertaken a programmatic line of research on collective induction, groups inferring some general principle or rule from concrete empirical manifestations of that principle. In a typical collective induction experiment, participants (individuals or groups) are first given an exemplar of some to-be-discovered rule involving standard playing cards. They are then asked to choose a new card, are

told whether the new card fits the rule, and then are asked to generate a hypothesis about what the rule might be. They then continue the process of card selection, feedback, and hypothesizing for several rounds until a final hypothesis is solicited.

Laughlin (1996, 1999) has proposed a set of postulates that both summarizes this program of research and constitutes a theory of how groups perform induction (and conceptually similar) problems. Several of these postulates (e.g., the distinction between intellective and judgmental tasks; criteria for solution demonstrability) are based on older research (preceding the time span covered in this review). However, several reflect more recent work. For example, a few common ways in which groups resolve preference disagreement among their members have been identified (Postulate 1) and each has been formalized using a particular social combination model or scheme (Postulate 2; Davis 1973) (e.g., random selection among alternatives = equiprobability decision scheme; voting = majority/plurality decision scheme; demonstration = truth-wins decision schemes). A few simple combination rules nicely organize the data for a large number of experiments (Laughlin 1988, 1992; Laughlin & McGlynn 1986; Laughlin & Shupe 1996; Laughlin et al. 1991, 1997, 1998a)—if more than one plausible hypothesis is proposed, group choice is restricted to that set of hypotheses (Postulate 7); if a majority favors a hypothesis, it will be the group's choice, but if there is no such majority, the group will use turn taking to make a choice (Postulate 8); absent a majority preference, a group with H viable hypotheses in hand will settle on a new, emergent hypothesis with a small but finite probability [estimated to be $1/(H + 1)$] (Postulate 8). From these, it follows that the unique correct hypothesis is very likely to be discovered by the group if and only if it is proposed by some group member on some trial—at least under the conditions modeled in this paradigm (errorless feedback, multiple trials); groups seem to be fairly effective in retaining correct and winnowing out incorrect hypotheses. Several studies (e.g., Karau & Williams 1997; Laughlin & Bonner 1999; Laughlin et al. 1995, 1998b) suggest that induction is facilitated more by additional evidence than by additional hypotheses (Postulate 11). It is well known that individuals tend to prefer confirmatory to disconfirmatory tests; this seems also to describe group induction. Moreover, in the Laughlin paradigm, with many plausible hypotheses evident initially, such a confirmatory strategy can also be shown (see Laughlin et al. 1997, 1998b) to be relatively more effective (Postulate 12). Finally, groups have been shown to perform near the level of the best in a like-sized set of individual performers, but only if the groups are given sufficient information and time (Postulate 10; Laughlin et al. 1995, 1998a); if time or information is sparse, groups will do less well (e.g., Laughlin et al. 1991).

GROUP DECISION MAKING

Group decision-making research in the 1960s and 1970s typically emphasized the processes involved in moving from a diverse set of individual positions or preferences to agreement on a consensus choice for the group. Stemming largely

from early work by social choice theorists (Arrow 1963, Black 1958), psychologists attempted to define formal models to describe the influence functions that led to consensus. Early models by Lorge & Solomon (1955), Smoke & Zajonc (1962), Steiner (1966, 1972), and others culminated in social decision scheme theory (Davis 1973) and its various offshoots (Kerr 1981, Penrod & Hastie 1981, Stasser & Davis 1981). The key topics of inquiry during that time involved jury decision-making (Hastie et al. 1983, Stasser et al. 1982, Tindale & Davis 1983), and group polarization or choice shift (Myers & Lamm 1976, Stasser et al. 1989).

These topics are still receiving attention on both theoretical and empirical levels. However, the dominant paradigm behind recent group decision-making research has focused on information rather than on preferences (Brauner & Scholl 2000, Hinsz et al. 1997, Kameda et al. 2002, Larson & Christiansen 1993). Stasser & Titus's (1985) now classic finding that groups were less-than-optimal users of information and often would ignore information that was not widely shared among the members presented a counterintuitive finding and a new paradigm for studying a variety of aspects of group decision-making and social influence. The "shared versus unshared information" paradigm has been replicated and expanded in a variety of interesting directions and become a mainstay of group research during the 1990s. Thus, much of our discussion focuses on information processing in and by groups trying to reach consensus on a given decision alternative.

Combining Preferences

Recent work on preference combination in groups has addressed continuous rather than discrete decision alternatives. Davis (1996) proposed his Social Judgment Scheme (SJS) model for groups as an extension of his earlier work on discrete-alternative consensus processes (i.e., Social Decision Schemes or SDS theory; Davis 1973). The SJS model is a weighted linear combination of member preferences where the weights are an exponential function of the distances between a given member's preference and all other members' preferences. (See Davis 1996 or Kameda et al. 2002 for a more complete description of the model.) The weight given to any member decreases exponentially as an increasing function of the discrepancy of that member's preference from the other members of the group. Thus, members whose preferences are similar to one another receive larger weights and members whose preferences deviate from most other members receive very little weight. Although formulated recently, the model has fared well in empirical tests (Davis 1996, Davis et al. 1993).

Crott et al. (1991) developed a model based on Black's (1958) work with single-peaked preference curves. Black showed that the median position among the group members dominates (in the game theoretic sense) any other possible position along the continuum, assuming member preference distributions are single peaked. Crott et al. (1991) found that a median model provided a good fit to group decision data from three different decision tasks. Davis et al. (1997) also found support for a median-based model using a civil-trial mock-jury task.

Both Davis's (1996) SJS model and Crott et al.'s (1991) median model are conceptually similar to majority/plurality models, which tend to well describe group consensus processes with discrete decision alternatives. As argued by Kameda et al. (2002; see also Tindale & Kameda 2000), like majority models, they show the influence of "social sharedness" at the preference level. The idea of social sharedness is that things that are shared among the group members tend to have an inordinate impact on the group response. For majority/plurality models, the alternative that shows the response option with the most sharedness tends to win or be chosen by the group. Both the Crott et al. (1991) median model and Davis's (1996) SJS model also emphasize the degree of preference sharing. The SJS model emphasizes shared preferences explicitly by giving more weight to those members whose preferences are similar (i.e., close to one another on the response dimension). It is easiest to see the sharedness aspect of the median model by comparing it to a model based on the mean when there is a skewed distribution of member responses. Extremely discrepant members in the tail of the distribution will have little impact on the median relative to the impact they would have on the mean. Thus, the median represents the most common or shared position even in skewed preference distributions. Recent work by Hinsz (1999) has argued that which members should be most influential in the group may also depend on the group's task or context. He has formulated a variety of models that differ as a function of the weights given to members based on their position along a judgmental continuum (e.g., most central member, most extreme member, etc.).

Another question that received attention in the past decade is whether groups attenuate or exacerbate individual decision biases (Kerr et al. 1996, Tindale 1993). Although groups tend to outperform individuals in many domains, groups also can fall prey to the same heuristic-based biases found at the individual level (Argote et al. 1990, Smith et al. 1998, Tindale et al. 1996, Whyte 1993). Tindale (1993) showed that a simple majority decision process can lead to either attenuation or exacerbation of a particular bias depending on how prevalent the bias is at the individual level. Kerr et al. (1996), using an SDS framework, showed that the question is far more complicated than it first appears. Using computer simulations, they showed that whether groups will be more, less, or equally as biased as individuals depends on (*a*) the type of bias, (*b*) the type of group decision process, (*c*) the strength of the bias, and (*d*) the individual preference distribution in the group. They also showed that not only could unbiased group decision processes exacerbate individual biases at the group level, but that biases may also influence the group decision processes (cf. Tindale et al. 1996). Recent empirical work inspired by the Kerr et al. framework has been generally supportive (Kerr et al. 1999).

Just as group decision-making research in general has been extended to continuous response distributions, research on jury decision making in particular has followed suit (see Tindale et al. 2001). Rather than focusing on criminal trials and categorical (guilty, not guilty) responses, recent work has focused on civil trials and the amount of compensation awarded to plaintiffs. Although earlier work showed juries in a relatively favorable light as mechanisms for administering

justice (Hastie et al. 1983), more recent findings on civil trials have suggested less sanguine conclusions. Work by Horowitz and his colleagues (Horowitz et al. 1996) has shown that jurors in civil trials often misinterpret jury instructions, mistakenly recall evidence, and fail to distinguish between different plaintiffs in a multiplaintiff case. In terms of damage allocations, juries are easily influenced by anchors provided during the trial (e.g., amount requested by the plaintiff; Hinsz & Indahl 1995). Sunstein et al. (2002) showed that although juries were consistent (i.e., showed high interjury reliability) in their judgments of negligence, their ability to follow judges' instructions regarding punitive damages was extremely poor. Juries were actually less consistent than individual jurors in punitive damage award judgments, often showing huge differences in awards across different juries and typically awarding punitive damages in cases where they were not warranted. Finding ways to alleviate such problems may be at the forefront of jury research in the near future.

Combining Preferences with Limited (or No) Discussion

The aforementioned models all deal with processes associated with how groups reach consensus through discussion. However, a number of lines of research have developed where discussion is either limited or nonexistent, and where the decision is made either by a single source or by a statistical algorithm. One of these lines of research involves "judge-advisor systems" (Budescu & Rantilla 2000, Sniezek 1992, Sniezek & Buckley 1995). In many decision settings, multiple people may provide advice to a decision maker, but the final decision is in the hands of a single person. Thus, a number of researchers have begun to assess how much influence the "advisors" have on the final decision of the "judges." The general finding is that advisors influence judges, but judges give their own positions more weight (Harvey et al. 2000, Yaniv & Kleinberger 2000). They also give more weight to advisors whose preferences are similar to their own (Harvey et al. 2000). These findings are similar to those for decision-making groups where shared preferences are likely to prevail, but postgroup individual preferences tend to move back toward each individual's initial position (Hinsz et al. 1997, Tindale & Kameda 2000). There is also evidence that judges are sensitive to the accuracy of the advice they receive. Advisors who have been correct in the past or who have more information at their disposal are given more weight than advisors with less-accurate records (Budescu et al. 2003). However, the best predictor of an advisor's influence is the advisor's level of confidence (Kuhn & Sniezek 1996, Van Swol & Sniezek 2002).

Overall, it appears that forecasters would be better off letting their judgments be generated by simple linear models, such as averages, than by using their own intuitive weighting schemes (Ariely et al. 2000, Johnson et al. 2001). Much as individual decision makers are not able to optimally use information at their disposal, it appears that groups rarely combine their individual preferences in an optimal way. Ariely et al. (2000) showed that, assuming pairwise conditional independence and random individual error distributions, the average of J probability estimates

(J = the number of estimators) will always be better than any of the component individual estimates and that as J increases, the average will tend toward perfect calibration diagnosticity (accurate representation of the true state of affairs), even when information provided to the various estimators is less than optimal. In addition, Johnson et al. (2001) empirically showed the accuracy of the average probability estimate to be robust over a number of conditions, even when individual estimates were not independent. Thus, decision makers' tendency to weight their own opinions heavier than those of their advisors may often be a suboptimal strategy.

Sorkin et al. (2001) approached the notion of optimal preference combination using a signal detection approach. Their model defines ideal group performance by using the individual members' sensitivity parameters (d') to set weights for combining the member preferences. Then, depending on the group's criterion, the model predicts when the group should choose one response over another (e.g., guilt versus innocence). The model can also be used to specify other types of decision rules, such as majority wins (Sorkin et al. 1998). One of the more interesting findings from both their empirical and simulation work is that majority processes tend to maximize group performance in situations where ideal weighting schemes are not possible (i.e., the members don't know each other's accuracy scores or d' values). In addition, simple majorities work better than more stringent criteria (e.g., two-thirds majorities, unanimity, etc.). Kameda & Hastie (1999) have also found that majority processes tend to produce high levels of decision performance with very little cost in terms of cognitive effort. They speculate that majority norms may have evolved in many cultures because of their adaptive properties.

Combining or Sharing Cognitions

Hinsz et al. (1997) argued that group research has shifted to an *information*-processing paradigm, and this is certainly true in the area of group decision making. Based on the groundbreaking work by Stasser & Titus (1985) on the dominant role of shared versus unshared information and the "hidden profile" procedure, numerous studies have explored the role of information distribution and exchange in group decision making. The initial finding—that groups focus on and discuss shared information at the expense of unshared information, thus leading to their failure to uncover hidden profiles—has been well replicated (see Wittenbaum & Stasser 1996). Research uncovering how and why the effect exists, and the contextual factors that moderate its strength, have proved fruitful ground for research.

Gigone & Hastie (1993, 1996) replicated the original Stasser & Titus (1985) findings using a multi-cue judgment task, and varied whether the cues were shared or unshared among the group members. Consistent with the Stasser & Titus (1985) findings, shared cues were more important for predicting group judgments than were unshared cues, with importance generally being a linear function of the degree of sharedness. Interestingly, cues that were actually brought up during discussion did not increase in weight as a function of their being mentioned.

In addition, the effects of the cues on group judgments were totally mediated by the member preferences. Thus, at least in this context, the distribution of information in the group (i.e., information or cognitive sharedness) influenced group judgments only indirectly through member preferences (i.e., preference sharedness). A more recent study (Winquist & Larson 1998) found that pooled (discussed) unshared information did impact positively on group decision quality when groups were given a sufficient amount of time to reach consensus.

Four basic processes seem to underlie the bias toward shared information. First, a simple information-sampling model (e.g., Stasser & Titus 1985) correctly predicts that shared information is more likely to be discussed, especially early in the discussion. Second, especially in hidden profile situations, premature closure may also play a role (Karau & Kelly 1992, Kelly & Karau 1998, Kruglanski & Webster 1996). The need to reach consensus in a situation where most of the members already share the same preference could lead to reduced information exchange and early consensus. Majority processes are quite consistent with this idea (Kameda et al. 2002). Third, it appears that people prefer to both receive and present information that is shared (Wittenbaum et al. 1999). People are perceived as more competent, knowledgeable, and credible when they share information that others already know. Finally, Brodbeck et al. (2002) and Greitemeyer & Schulz-Hardt (2003) show that group members do not like to change their initial preferences once formed. Thus, hidden profiles, which lead to biased individual preferences, can also lead members to misinterpret new information that is inconsistent with their already formed preferences.

More recent studies have documented a variety of moderators of this phenomenon (F.C. Brodbeck, R. Kerschreiter, A. Mojzisch, & S. Schulz-Hardt, unpublished manuscript). First, Larson et al. (1994) have shown that unshared information becomes more prevalent in group discussion over time. Thus, extending the discussion time of groups should improve the chance that unshared information is brought up during discussion. Placing all of the unshared information (assuming this information has implications for the decision quality) in the hands of at least one group member has also been shown to increase its effect on the final group decision (Stasser & Stewart 1998, McLeod et al. 1997). Work by Sawyer (1997) and Sheffey et al. (1989) has shown that allowing group members to have access to informational records (rather than relying on memory) during discussion can attenuate hidden profile effects. There is some evidence that training group members to explore more information can aid in information exchange (Larson et al. 1994; Wittenbaum 1998, 2000). Sometimes a group leader can aid in information sharing as well (Larson et al. 1996), as can having at least one group member who is an advocate for the alternative favored by unshared information (Brodbeck et al. 2002). Assigning group members to be responsible for certain categories of information and making sure that knowledge of who knows what is shared among the group members (like a transactive memory system; Wegner 1987, Stewart & Stasser 1995) has improved performance in hidden profile situations, as has convincing group members that there exists a unique correct solution to its decision

task (Stasser & Stewart 1992). Increasing the amount of preference diversity (Brodbeck et al. 2002) or having members rank order alternatives (Hollingshead 1996) can also improve information sharing and decision quality. Finally, there is recent evidence that splitting the decision task into two components—information search first, followed by integration and decision—helps to insure that all relevant information is aired and used in the group decision (F.C. Brodbeck, R. Kerschreiter, A. Mojzisch, & S. Schulz-Hardt, unpublished manuscript).

Cognitive Centrality of Group Members

Recent work by Kameda et al. (1997) extended the idea of knowledge sharing to look at the influence members have within the group as a function of how much information they share with others. Using a social network framework, Kameda et al. devised a model to represent the degree to which any given member was "cognitively central" in the group. 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. Both when cognitive centrality was measured (Study 1) and manipulated (Study 2), groups were more likely than not to choose the preference held by the most cognitively central member even when that member held the minority view. Kameda et al. (1997) argue that the enhanced social power accrues from perceptions of expertise for the cognitively central member in the focal knowledge domain, which fits nicely with Wittenbaum et al.'s (1999) findings concerning perceived competence as a consequence of mentioning shared information. However, Sargis & Larson (2002) found that cognitively peripheral members (those holding more unique information) can be influential when their information is perceived as important for the task. In addition, Spoor et al. (2002) found that females in mixed gender groups were less influential when they were cognitively central (compared to when they were more peripheral). Thus, considerably more research on this topic is needed before a clear understanding of the role of cognitive centrality in group decision making can be achieved.

Shared Task Representations and Mental Models

Specific pieces or types of information are not the only cognitive elements that group members can share (Tindale & Kameda 2000). Laughlin (1980, 1999) has argued that one of the reasons groups are better problem solvers than are individuals is that they may share a conceptual system of ideas that allows them to realize when a proposed solution is correct within that system, the first element of his notion of demonstrability (Laughlin & Ellis 1986). Tindale et al. (1996) referred to such shared conceptual systems as "shared task representations" and have argued that they can influence both group processes and outcomes. In essence, Tindale et al. argue that decision alternatives that fit within or are supported by the shared representation are easier to defend, and thus more likely to be chosen by the group. Thus, majorities or minorities favoring the alternative consistent with the shared

representation will be more powerful within the group (relative to comparably large majorities/minorities favoring other alternatives).

Tindale et al. (1996) argue the group problem solving work by Laughlin (1980) and the work on the "leniency bias" in mock jury decision making (Davis 1980, MacCoun & Kerr 1988, Tindale & Davis 1983) are both instances of shared representation effects. More recently, Tindale et al. (1996) have shown that shared decision biases or heuristics can produce similar deviations from symmetric majority processes. For example, Tindale et al. (1993) found that groups given the "loss" framing of the standard "Asian disease" problem (Tversky & Kahneman 1981) would choose the riskier alternative even when a majority of the members favored the less risky alternative.

Recent research has shown that shared representations potentially operate in two different ways to affect group decisions. First, Smith et al. (1998), using a "sunk cost" problem, found that sunk cost arguments were persuasive, even if only a minority of members mentioned them as reasons for their decisions. Second, Tindale et al. (1998), examine videotaped group discussions of conjunction problems (cf. Tindale et al. 1993a) and showed that groups rarely discussed strategies, but rather simply exchanged information concerning their individual judgments, and quite often (greater than 60% of the time) simply chose a single member's undefended judgment. When this occurred, they were more likely to endorse the judgment of an incorrect member for conjunction problems that typically led to errors, but more likely to endorse the judgment of a correct member for conjunction problems that typically did not lead to errors. Thus, as long as a given individual preference is plausible within the shared representation, the group members may find it acceptable without thorough debate.

Shared task representations might best be conceptualized as a component of mental models that are shared among the group members (Cannon-Bowers et al. 1993, Helmreich 1997, Hinsz 1995). Although mental models can be shared without member awareness, shared meta-knowledge of the model (i.e., knowledge of what other members know and their role within the system) should aid groups in using the model effectively. Cannon-Bowers et al. (1993) have distinguished between models of the task and models of the group itself (i.e., what group members are likely to do or know—e.g., transactive memory) and have argued that both are important. Although research is still rather sparse, most findings to date support the idea that groups function better (made better choices, worked more efficiently, etc.) when they share the same ideas as to what the task is and the roles that the various members play (Mathieu et al. 2000). Although shared mental models may develop over time, they can also be instantiated effectively through training (Helmreich 1997, Marks et al. 2000).

Group Decision Making Procedures

Although group information processing and continuous response distributions have been particularly active topics for group research over the past decade, a number of

other topics/issues have received attention as well. Continuing the traditions from social choice theory, agenda or procedural issues are still being actively explored (see Kameda et al. 2002). Davis and his colleagues (Davis et al. 1993, 1997) have continued to examine the role of straw polls, voting orders, group size, etc., in civil mock juries. They have found that polling a jury early can lead to quicker decisions, but may increase the likelihood of a hung jury. And similar to earlier findings with mock criminal juries (Davis et al. 1989), early poll responses can influence those voting later in the sequence.

Kameda (1996, 1991; Kameda & Sugimori 1993, 1995) has studied the implications of different voting procedures, including some not typically seen in Western cultures. For example, Kameda (1996) compared *nemawashi*—an informal consensus seeking technique that involves a leader contacting each group member individually and offering inducements for compliance—to a variety of other consensus generating procedures (mean, median, relative power, etc.). Interestingly, *nemawashi* faired relatively poorly except in relation to dictatorial decision procedures. Kameda (1991) also showed that breaking apart a decision into component parts can change the types of decisions groups will reach. Even if two of three members of a group are against some policy in total, if they disagree on which parts of the overall proposal they do not like, voting on separate components can lead to the group endorsing the overall proposal. In addition, Kameda & Sugimori (1995) showed that minority positions within a group become more likely to be chosen if the overall group is broken into subgroups and subgroups are allowed to make decisions before subgroup decisions are combined.

Groupthink

Another topic of longstanding interest that has continued to receive research attention is groupthink—Janis's (1972, 1982) delineation of a set of conditions and processes that can lead to disastrous outcomes for decision making groups. Although the historical illustrations and logic of groupthink remain compelling (e.g., see the special issue of *Organizational Behavior and Human Decision Processes,* Vol. 7, 1998) and are often cited in textbooks on groups, the research support for the theory has been quite mixed. It appears that both good and poor decision outcomes can occur because of and in spite of many of the conditions hypothesized to trigger groupthink. For example, the work on hidden profiles (Wittenbaum & Stasser 1996) and shared task representations (Tindale et al. 1996) shows that groups can make disappointingly poor decisions without being highly cohesive, having strong and directive leaders, or feeling a sense of urgency. Conversely, there is evidence that strong, directive leaders can sometimes enhance performance (Peterson et al. 1998), as can cohesiveness (though only under some circumstances, Mullen et al. 1994). Probably the main contribution of the theory in the long run will be the provocative research that it spawned, research that has shown us that constructs that typically are seen as positive aspects of groups (cohesiveness, collective efficacy, etc.) do not invariably lead to improved group outcomes (Mullen et al. 1994, Whyte 1998).

CONCLUDING THOUGHTS

We began this chapter by likening it to a confession. Like a confession, its aim has been to look back at what has been done and to look forward to how things might be done better. With these aims in mind, we conclude by describing some patterns that have characterized the last decade plus of research on small group performance and decision making, and by offering a few prescriptions for future research.

General interest in group processes has waxed and waned in psychology. Moreland et al. (1994) analyzed such trends and found that after nearly three decades of declining publication rates, there has since the late 1980s been a steady rise in publications on groups. However, they also show that little if any of that increase stemmed from work on intragroup processes (our present focus). Rather, the recent growth in group research can largely be attributed to the study of individual cognition about groups (e.g., stereotype formation, perceived group homogeneity) and to approaches popular in European social psychological circles with clear relevance to groups, but with a clear interpersonal (e.g., minority influence) or intergroup (e.g., social identity theory) focus. For those interested in intragroup processes, per se, this could be viewed as a half-empty glass. On the other hand, as this chapter and more-quantitative analyses (Moreland et al. 1994, Hogg & Moreland 1995) demonstrate, research on intragroup processes continues to represent a substantial and fairly constant share of the whole group research enterprise. Filling the glass must await progress in linking knowledge at these different levels of analysis. So far the strongest efforts have been made to apply individual-level cognitive and information processing models to the analysis of group processes, but attempts are also being made for similar applications from or to more interpersonal (e.g., Kerr 2001a) and intergroup (e.g., Haslam 2001, Wildschut et al. 2002) level models.

One theme that runs through both the recent performance and decision making literatures is that a single basic processes in groups can lead to both good versus poor performance, depending on the context in which that processes is enabled. For example, both motivation losses and gains can largely be explained using the notion of instrumentality in an expectancy-value framework (Karau & Williams 1993; Kerr 2001b). Something similar can be seen in decision-making groups. A simply majority processes tends to allow groups to perform better than individuals (reach more optimal solutions, make fewer errors, etc.) typically because most individuals will more often favor the correct or better alternative. However, a bias or heuristic at the individual level which tends toward a less optimal strategy will lead the same majority process in the group to result in poorer decisions relative to individuals working alone. Whereas earlier work attempted to explain good vs poor performance with different types of group processes, much of the more recent work has shown how the same processes can lead to both types of outcomes.

Considerable interest and attention is being paid in contemporary psychology (e.g., Snyder & Lopez 2002) to "positive psychology," which emphasizes adaptive human functioning (in contrast to a more traditional focus on human error,

suboptimality, or pathology). A traditional focus in small group performance research has been on group suboptimality—groups tend to do perform better than individuals, but not as well as they could. But a theme that runs through much of the more recent work is that basic group processes can result in performance that meets or even exceeds reasonable expectations. In many instances, groups are satisficing entities–often it's not that groups cannot perform near their upper limits, it's that they simply don't need to. If a simple combination of member judgments tends to produce reasonably accurate probabilistic estimates, the additional effort necessary to make the combination "as accurate as it can possibly be" may often not be worth it. If a simply majority is more-often-than-not correct, then the additional effort necessary to figure out when they might be wrong may be inefficient (Kameda & Hastie 1999). Many group norms may have developed because they work most of the time and require little processing effort. The dominance of shared information may also reflect group satisficing. If all of the members of a group know something, it probably does have more validity than something that is only known by one member. Ideas that are shared among the group members will dominate because they require no additional justification–new ideas presented by only one person will need further elaboration and will only be influential to the degree that they appear to be important. Thus, much of the work discussed under the rubric of "social sharedness" (e.g., Kameda et al. 2002, Tindale & Kameda 2000) can be seen as demonstrating the satisficing nature of groups. Such considerations should encourage us to take a broader view of group effectiveness, considering such matters as how efficient various group processes are and how certain group processes that contribute to ineffectiveness in one context might be quite useful heuristics in many (or even most) other contexts.

A common criticism of much small-group research is that it oversimplifies an obviously complex set of processes. Much of the past work on small group decision-making has tended to focus on linear, antecedent-consequence type relations with manipulations of independent variables (e.g., group size, task type) causing changes in dependent variables (e.g., group choice, implicit decision scheme). Although this approach has taught us much about group decision-making, its very nature focuses attention on one or a few variables while ignoring virtually all others. There is general agreement that groups are certainly more complex than most of our theories and methods would suggest. The difficulty has and continues to be, "how can this complexity best be analyzed and understood?" It is worth noting a few fairly recent and promising ways of addressing such questions.

- One is Arrow, McGrath & Berdahl's (2000) ambitious attempt to develop a complex systems theory of small group formation, coordination, development, and adaptation. This theory has yet to receive much research attention (though see Berdahl 1998, 1999).
- A second is the use of dynamic systems approaches (e.g., Vallacher & Nowak 1994) to the study of group processes, best illustrated by research on dynamic social impact theory (Nowak et al.1990, Latané & Bourgeois 2001). A number

of very interesting findings have emerged from the simulation and empirical work utilizing this theory (e.g., many social influence processes produce spatial clusters where everyone holds similar opinions; such clustering depends on the structure of available communication channels; Latané & L'Herrou 1999).

- A third is the use of evolutionary principles and models to explore the adaptiveness of various forms of group decision making. For example, some scholars have argued that the popularity of majority-rules based on shared preferences may stem from their adaptive value. Such decision processes can effectively constrain self-interested behavior to the advantage of group (and species) fitness (Henrich & Boyd 1998; Kameda et al. 2002) and provide "fast and frugal" heuristics in diverse and complex decision environments (Kameda & Hastie 1999, Sorkin et al. 2001).
- A fourth utilizes the tools of modern information technology to pose questions that might never arise in the usual contexts of face-to-face groups. Research discussed earlier (e.g., on computerized brainstorming and electronic groups) as well as other fascinating new topics (e.g., using virtual reality to create and analyze group processes; Blascovich 2001) illustrates this exciting new approach to the study of groups (McGrath & Berdahl 1998).

We end our review (like a confession) with an appeal for absolution—from the scholars whose relevant work we may have missed or mischaracterized, and from you, the reader, who may have been misled by our errors of omission or commission. Please have mercy on us, contrite suboptimal scholars. Our penance will be to read carefully all the missed or misunderstood papers that are certain to be brought to our attention.

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