TO ERR IS HUMAN, TO CORRECT FOR IT DIVINE
A Meta-Analysis of Research Testing the Functional Theory of Group Decision-Making Effectiveness

MARC ORLITZKY
Australian Graduate School of Management
RANDY Y. HIROKAWA
University of Iowa

This meta-analysis tests the functional perspective of small-group decision making, which holds that certain critical requisite functions must be satisfied for an effective group decision to be likely. The results suggest that evaluation of negative consequences of alternative solutions, problem analysis, and establishment of solution criteria (in this order) are the strongest predictors of group decision-making effectiveness. In addition, methodological study artifacts (sampling error, measurement error) and task moderators explain variability in previous findings. More specifically, the moderator subgroup analysis shows that evaluation of negative consequences is an even better predictor of group performance when task evaluation demands are high.

The question of why some groups arrive at better decisions than others has long been of interest to group and organizational scholars in a variety of academic disciplines. Efforts to address this puzzle have led to the widely held view that variations in the quality of group decisions can, in many cases, be attributed to the quality of the interaction, or communication, that precedes choice making in

AUTHORS' NOTE: *We are grateful for Frank Schmidt's comments on earlier drafts of this article.* *Correspondence concerning this article should be addressed to Marc Orlitzky, Australian Graduate School of Management, UNSW Sydney NSW 2052, Australia; phone: (011612) 9931-9437; fax (011612) 9313-7279; e-mail: marco@agsm.edu.au.*

SMALL GROUP RESEARCH, Vol. 32 No. 3, June 2001 313-341

the group (Collins & Guetzkow, 1964; Gouran & Hirokawa, 1983; Hackman & Morris, 1975; Hirokawa, 1982; Janis & Mann, 1977; McGrath, 1984). Such a conclusion, for example, is reflected in Steiner's (1972) formula: "Actual productivity = potential productivity – losses due to faulty processes" (p. 9). Presumably, when communication is functioning well, actual productivity would approach potential productivity.

According to some scholars (e.g., Cragan & Wright, 1990, 1993; Pavitt, 1994), one of the more promising theoretical frameworks that accounts for the relationship between communication and group decision-making effectiveness is the functional theory of group decision making (Gouran & Hirokawa, 1983, 1986, 1996; Gouran, Hirokawa, Julian, & Leatham, 1993; Hirokawa, 1980a, 1980b, 1982, 1985, 1988, 1996). The core notion of the functional theory is that effective group decision making is contingent on interactions' contributing to the satisfaction of critical task requirements. The rudiments of this theory are drawn from the pioneering work of Dewey (1910), Bales (1950, 1953), and Janis (1972, 1982; Janis & Mann, 1977).

Over the years, the functional theory of group decision-making effectiveness has undergone change, with slight variations in the proposed critical functions necessary to reach an effective decision.[1] In general, however, empirical tests of the functional theory have focused on the relationship between group decision-making performance and a group's ability to satisfy five requisite functions during its decision-making interaction (Hirokawa, 1985, 1988, 1990). They include the following:

1. Developing a thorough and accurate understanding of the problem (*problem analysis*). Given the information available to it, the group needs to arrive at an accurate (i.e., reasonable) understanding of (a) the nature of the problem, (b) the extent and seriousness of the problem, (c) the likely cause(s) of the problem, and (d) the possible consequences of not dealing effectively with the problem.
2. Achieving an appropriate understanding of the requirements for an acceptable choice (*establishment of evaluation criteria*). The

group must recognize the specific standards that the choice must satisfy to be judged acceptable by evaluators of that decision.

3. Marshaling and, if necessary, developing a range of realistic and acceptable alternatives (*generation of alternative solutions*). The group must generate, or be aware of, a number of appropriate and feasible alternative choices among which an acceptable choice is assumed to exist.
4. Assessing thoroughly and accurately the positive consequences associated with alternative choices (*evaluation of positive consequences of solutions*). Given the information available to it, the group needs to be fully cognizant of the relative merits of all available alternatives.
5. Assessing thoroughly and accurately the negative consequences associated with alternative choices (*evaluation of negative consequences of solutions*). Given the information available to it, the group needs to be fully cognizant of the relative disadvantages associated with each alternative choice.

INCONSISTENCIES IN FINDINGS DUE TO METHODOLOGICAL ERROR OR REAL MODERATING VARIABLES?

Empirical tests have yielded general support for the functional theory of group decision-making effectiveness. However, comparisons of findings across studies also indicate that group decision-making effectiveness appears to be inconsistently related to requisite functions. Methodological limitations notwithstanding (Gouran, 1991; Gouran et al., 1993; Hirokawa, 1987), the cross-study variability of empirical relationships (between the critical functions and group decision-making effectiveness) has raised the issue of whether real contingency variables affect the performance of critical functions.[2] The one contingency variable that has attracted most attention is the nature of the task employed. Differences in tasks have been discussed on three dimensions: task structure, information requirements, and evaluation demands (Hirokawa, 1990).

TASK STRUCTURE

According to Hirokawa (1990), task structure consists of *goal clarity* (the degree to which the group is aware of the end states that need to be achieved for successful task completion), *goal-path clarity* (the degree to which the group is cognizant of the proper means to achieve desired end states), *goal-path mechanics* (the number of operations or steps that need to be performed to achieve desired end states), and *goal-path obstacles* (the number of barriers that may hinder a group's efforts to achieve its desired end states). A complex task is defined as a task having unclear goals, many goal-path mechanics, many goal-path obstacles, and low goal-path clarity. Hirokawa asserts that when task structure is complex, the group will have a greater need for problem analysis, procedural orientation, and planning. This, in turn, implies that, for complex tasks, problem analysis is hypothesized to be more highly correlated with decision-making effectiveness than it is in the case of simple tasks. Generally, the association between decision-making effectiveness (group performance as rated by others) and all group process functions is expected to be higher, in general, for complex tasks than for simple tasks. These relationships are explained by the fact that for simple tasks, input variables tend to be more important than process variables, whereas for relatively complex tasks, process variables outweigh input variables in importance (Hirokawa, 1990). Finding solutions to simple problems does not require the kind of communicative interdependence necessitated by complex tasks.

Hypothesis 1a: Task structure acts as a moderator of the functional theory of group decision-making effectiveness, so that in complex tasks all five group communication process functions (and especially problem analysis) are more highly related with decision-making effectiveness than in relatively simple tasks.

INFORMATION REQUIREMENTS

The second potential contingency variable is information requirements. Information requirements are determined by (a) *informa-*

tion distribution, the extent to which group members possess the information necessary to complete the task and (b) *information-processing demand*, the amount and complexity of information that must be applied to complete the task. If information is unequally distributed and information-processing demand is high, the information requirement is said to be means-interdependent (Hirokawa, 1990). For means-interdependent information requirements, all critical functions are hypothesized to be more important than for means-independent information requirements.

Hypothesis 1b: Information requirements act as moderators of the functional theory of group decision-making effectiveness, so that in means-interdependent tasks all five group communication process functions are more highly related with decision-making effectiveness than in means-independent tasks.

EVALUATION DEMANDS

The third contingency factor is evaluation demands. Evaluation demands are affected by three task elements: (a) *solution multiplicity* (SM), the number of choices deemed "correct" or acceptable; (b) *criteria clarity* (CC), the extent to which the standards of evaluation are clearly presented; and (c) *objective verifiability* (OV), the extent to which a choice can be definitively established to be correct or acceptable. If a task is equivocal (i.e., high in SM, low in CC, and low in OV), all process functions become important relative to unequivocal tasks. Thus, as was the case with task structure and information requirements, where the nature of the task contingency affected the association of all functions with group decision-making effectiveness, the functional perspective should receive less empirical support for unequivocal tasks because they pose fewer critical group process requirements. More specifically, the group process requirements of criteria identification, solution generation, and solution assessment have been hypothesized to assume greater importance for equivocal tasks (Hirokawa, 1990).

Hypothesis 1c: Evaluation demands act as moderators of the functional theory of group decision-making effectiveness, so that in equivocal tasks all five group communication process functions (and especially positive and negative solution assessment) are more highly related with decision-making effectiveness than in unequivocal tasks.

STUDY ARTIFACTS

In contrast to the aforementioned task contingencies that may moderate the effect of the five communication functions (Hypotheses 1a-1c), a quantitative review of previous research on the functional theory may also show that most cross-study variance is explained by two methodological study artifacts, namely sampling error and measurement error. Sampling error is the deviation of sample sizes in primary studies from the population (whose size can often be assumed to be infinite) and is captured by the formula, $\sigma_e = (1 - \ {}^2)/\sqrt{(N)-1}$. Measurement error (i.e., deviation from perfect measurement = unreliability) systematically attenuates observed statistical relationships reported in primary studies. In many areas of social psychology and organizational behavior (OB), the advent of meta-analysis has resulted in a more skeptical attitude toward a host of contingency theories. Many previous meta-analyses in OB and human resources have shown that what had been assumed to be real contingencies accounting for cross-study variability in findings was nothing but sampling error and measurement error in disguise (Hunter & Schmidt, 1990a).

Hypothesis 2: Sampling error and measurement error account for most cross-study variance in observed correlations between the five communication functions and group decision-making effectiveness.

PURPOSE OF STUDY

The present study uses meta-analysis (Hunter & Schmidt, 1990a) to evaluate the predictive validity of the functional theory. First, the meta-analysis computes the so-called "true-score" correlation   between each of the five communication functions and group decision-making effectiveness. *Rho* ( ) is a correlation coefficient that has been corrected for sampling error and measurement error. In psychometric theory, corrected scores are called true scores, which more accurately reflect the underlying (latent) constructs. Second, the study investigates the amount of cross-study variance that may be attributable to real task contingencies (Hypotheses 1a-1c) or methodological study artifacts (Hypothesis 2).

METHOD

Meta-analysis is a quantitative method of research integration (Cooper, 1989). Increasingly, it has replaced the narrative literature review as a more valid technique of summarizing a research stream. We relied on the meta-analytic guidelines provided by Hunter and Schmidt (1990a). Their meta-analytic techniques correct the observed sample statistics (e.g., the observed correlation r in primary studies) for methodological distortions due to sampling error and measurement error (see above). These distortions are called *study artifacts*.

Each observed correlation must be weighted by the sample size of the primary study to calculate the observed mean weighted correlation (r_{obs}) across all of the studies involved in the analysis. The standard deviation of the observed correlations can then be computed to estimate the variability in the relationship between the variables of interest. The total variability across studies includes several components, such as the true variation in the population, variation due to sampling error, and variation due to other artifacts (e.g., lack of reliability in measures). Recognition and control of these artifacts allow for a better estimate of the true variability around the population correlation. Thus, the most important outcome of the meta-analysis is the population parameter (i.e., the estimated corrected or true-score correlation) between two variables. This way, we can obtain an estimate of the true relationship between the communication functions and group decision-making effectiveness. For further, more technical explanations of the underlying meta-analytic procedures, please refer to the details provided in the Methodological Appendix.

LITERATURE SEARCH

Copies of existing studies based on the functional theory of group decision-making effectiveness were obtained using computer searches of three different databases: ERIC, WLS2, and PsycINFO (PSYL and PSYB). The searches covered the years 1980 to 1999 (ERIC), 1982 to 1999 (WLS2), 1967 to 1999 (PSYL), and 1987 to 1999 (PSYB). Although records earlier than 1967 were not included in the literature search, this is not a problem in this case because formal discussions and tests of the functional perspective did not appear in the literature until 1980 and thereafter (Gouran et al., 1993).

This article is an explicit integrative test of Hirokawa's functional theory, with particular attention to a number of postulated task contingencies. In any meta-analysis, comparability across studies in terms of study design and operationalization of variables is important (Algera, Jansen, Roe, & Vijn, 1984; Presby, 1978). Although other previous studies in the group communication literature arguably tested constructs similar to Hirokawa's (1980a, 1980b, 1983, 1985) conceptualization of group communication functions, we were very concerned with concept-to-operation correspondence (Cooper, 1989) and, thus, cast the research question in a fairly narrow light. With this conservative method of research integration maximizing homogeneity of variable operationalizations across studies, we can avoid, to some extent at least, the criticism of "mixing apples and oranges" leveled against so many meta-analyses (e.g., Hunter & Schmidt, 1990a, pp. 480-481, 516-517).

CRITERIA FOR STUDY INCLUSION

A number of criteria for relevance were used to determine which studies to include in the meta-analysis. Because this research was an explicit empirical test of the communication functions as postulated and operationalized by Hirokawa (1980a, 1980b, 1983, 1985), studies that only vaguely dealt with similar conceptualizations of either the independent or dependent variables included in the theory were excluded a priori. For example, although there are some conceptual similarities between the functional perspective and Dewey's (1980) five steps of critical thinking, any studies that applied Dewey's theory to a small-group setting would be excluded on theoretical grounds. Also, Jehn and Shah (1997), for instance, was excluded because the study used slightly different concepts and included an incomplete set of Hirokawa's communication functions. The relevance of a given study was based on our reading of abstracts. In those cases in which the nature of the article was not clear (e.g., qualitative versus quantitative study of the functional perspective), we read the full report.

The studies deemed relevant for this meta-analysis had the following three characteristics. First, they entailed quantitative examinations of the effects of Hirokawa's task communication functions on group decision-making effectiveness. Second, independent (communication functions) and dependent (group decision-making effectiveness) variables were recorded as continuous measures—or corrections were made for discontinuous measures before data entry (Hunter & Schmidt, 1990a, 1990b). Third, a double-blind procedure was used to collect group process data and record decision-making effectiveness, the dependent variable.

Contrary to the deliberately narrow theoretical and operational delimitation, publication was not a criterion for relevance. We also contacted scholars who we knew had conducted empirical studies of the functional theory but whose research reports were as yet unpublished. These scholars' research reports were requested by regular mail and e-mail. Follow-up telephone calls were made in cases in which the report was not obtained within 2 months. In short, publication bias (or what is generally called *availability bias*) was reduced as much as possible in the early stages of the study.

However, a file drawer analysis (FDA) was still conducted to double-check whether we should be concerned about any remaining availability bias (Rosenthal, 1979). To determine the extent of availability bias in the meta-analyzed set of studies, Hunter and

Schmidt's (1990a) effect size FDA was used. This approach lets us know how many missing unlocated studies averaging null findings would have to exist to bring the r_{obs} down to some specific critical level (r_c; in this case, $r_c = .10$). Hunter and Schmidt (1990a) have provided the formulae for the FDA (pp. 512-513). The FDA is reported in the Results section.

CHARACTERISTICS OF PRIMARY STUDIES

Most of the studies were conducted as laboratory experiments involving college student populations. Group sizes typically were 3 or 4 members. Group process data were either collected *in loco* or group interactions were videotaped, and hypothesis-blind, trained interaction coders (mostly undergraduate and graduate students majoring in communication studies) coded the interactions while watching the tapes. Important study characteristics are summarized in Table 1.

The reliability estimates when given for the independent variables (r_{xx}) were intercoder assessments, based on either Ebel's (1951) intraclass correlation procedure or Guetzkow's (1950) formula.[3] In the primary studies, the reliability (r_{yy}) of group decision-making effectiveness (the dependent variable) was also assessed through Ebel's intraclass correlation procedure. When coders in the primary studies scored several dimensions of decision-making effectiveness across groups (e.g., reasonableness, fairness, or economic feasibility), the average reliability estimate was used in the meta-analysis.

All studies were initially coded (in a binary format) according to the task contingencies presented above. Studies were coded in terms of task structure (reverse coded, so that 0 referred to a simple task, i.e., high task structure, and 1 to a relatively complex task), information requirement (0 = low, 1 = high), and evaluation demand (0 = low, 1 = high). Thus, a study coded as (0, 0, 0) used a relatively tractable task, whereas one coded as (1, 1, 1) entailed a relatively intractable task. The subsets were created by subdividing the complete set of studies by the primary moderator variable hypothesized by Hirokawa (1990), which was task structure in the

TABLE 1: Quantitative Overview of Studies Used in the Meta-Analysis (dependent variable [DV]: group decision-making effectiveness)

Author	*Date*	*Observed* r	n	*Reliability of IV* (r_{xx})	*Reliability of DV* (r_{yy})	*Task Contingincies (TS, IR, ED)*[a]
a: Independent variable (IV): problem analysis						
Hirokawa	1983	.45	18	.925	.85	(1, 1, 1)
Hirokawa & Pace	1983	NA		.76	.70	
Hirokawa	1985	.625	48	.89	.89	(1, 0, 1)
Hirokawa	1988	NA	42	.82	.82	
Nakanishi	1990	.32	24	.95	.87	(0, 0, 0)
Nakanishi	1990	–.03	24	.95	.87	(1, 1, 1)
Hirokawa & Rost	1992	.90	9	.84	.82	(0, 0, 1)
Cragan & Wright	1993	NA		.77	.195	
Hirokawa, Oetzel, Aleman, & Elston	1994	.83	10	.88	NA	(0, 0, 0)
Hirokawa et al.	1994	.85	10	.88	NA	(1, 1, 1)
Hirokawa et al.	1994	.65	9	.78	NA	(0, 0, 0)
Hirokawa et al.	1994	.76	7	.78	NA	(0, 0, 0)
Hirokawa et al.	1994	.69	3	.78	NA	(0, 0, 0)
Propp & Nelson	1995	.032	29	NA	.986	(0, 0, 0)
Graham, Papa, & McPherson	1996	NA		.925	.87	
b: Independent variable (IV): establishment of evaluation criteria						
Hirokawa	1983	.14	18	.925	.85	(1, 1, 1)
Hirokawa	1988	NA	42	.84	.82	
Nakanishi	1990	.22	24	.95	.87	(0, 0, 0)
Nakanishi	1990	–.03	24	.95	.87	(1, 1, 1)
Hirokawa & Rost	1992	.19	9	.84	.82	(0, 0, 1)
Cragan & Wright	1993	NA	19	.69	.195	
Hirokawa et al.	1994	.13	10	.91	NA	(0, 0, 0)
Hirokawa et al.	1994	.93	10	.91	NA	(1, 1, 1)
Hirokawa et al.	1994	.59	9	.83	NA	(0, 0, 0)
Hirokawa et al.	1994	.31	7	.83	NA	(0, 0, 0)
Hirokawa et al.	1994	.62	3	.83	NA	(0, 0, 0)
Propp & Nelson	1995	.066	29	NA	.986	(0, 0, 0)
Graham, Papa, & McPherson	1996	NA	17	.925	.87	
c: Independent variable (IV): generation of alternative solutions						
Hirokawa	1983	.36	18	.925	.85	(1, 1, 1)
Hirokawa	1985	–.082	48	.86	.885	(1, 0, 1)

(continued)

TABLE 1 Continued

Author	*Date*	*Observed* r	n	*Reliability of IV* (r_{xx})	*Reliability of DV* (r_{yy})	*Task Contingincies (TS, IR, ED)*[a]
Nakanishi	1990	–.02	24	.95	.87	(0, 0, 0)
Nakanishi	1990	.06	24	.95	.87	(1, 1, 1)
Propp & Nelson	1995	.376	29	NA	.986	(0, 0, 0)
Graham, Papa, & McPherson	1996	NA	17	.925	.87	
d: Independent variable (IV): evaluation of positive consequences of solutions						
Hirokawa	1983	–.40	18	.925	.85	(1, 1, 1)
Hirokawa	1985	.297	48	.90	.885	(1, 0, 1)
Hirokawa	1988	NA	42	.79	.82	
Nakanishi	1990	–.40	24	.95	.87	(0, 0, 0)
Nakanishi	1990	–.23	24	.95	.87	(1, 1, 1)
Hirokawa & Rost	1992	.92	9	.84	.82	(0, 0, 1)
Cragan & Wright	1993	NA		.68	.195	
Hirokawa et al.	1994	.36	10	.92	NA	(0, 0, 0)
Hirokawa et al.	1994	.33	10	.92	NA	(1, 1, 1)
Hirokawa et al.	1994	.67	9	.79	NA	(0, 0, 0)
Hirokawa et al.	1994	–.21	7	.79	NA	(0, 0, 0)
Hirokawa et al.	1994	.84	3	.79	NA	(0, 0, 0)
Propp & Nelson	1995	.548	29	NA	.986	(0, 0, 0)
Graham, Papa, & McPherson	1996	NA	17	.925	.87	
e: Independent variable (IV): evaluation of negative consequences of solutions						
Hirokawa	1985	.919	48	.88	.885	(1, 0, 1)
Hirokawa	1988	NA	42	.81	.82	
Hirokawa & Rost	1992	.96	9	.84	.82	(0, 0, 1)
Cragan & Wright	1993	NA		.78	.195	
Hirokawa et al.	1994	.87	10	.89	NA	(0, 0, 0)
Hirokawa et al.	1994	.89	10	.89	NA	(1, 1, 1)
Hirokawa et al.	1994	.29	9	.88	NA	(0, 0, 0)
Hirokawa et al.	1994	.89	7	.88	NA	(0, 0, 0)
Hirokawa et al.	1994	.50	3	.88	NA	(0, 0, 0)
Propp & Nelson	1995	.294	29	NA	.986	(0, 0, 0)
Graham, Papa, & McPherson	1996	NA	17	.925	.87	

a. TS = task structure (reverse coded; 0 = high = simple task, 1 = low = complex task); IR = information requirements (0 = low = means-independent, 1 = high = means-interdependent); ED = evaluation demands (0 = low = unequivocal task, 1 = high = equivocal task).

case of problem analysis and evaluation demands in the case of solution assessment (both positive and negative). The task characteristics were assessed by two independent coders, with an interrater reliability of .91 using Guetzkow's (1950) extrapolation procedure.

RESULTS

INTEGRATIVE, QUANTITATIVE OVERVIEW OF THE PRIMARY STUDIES

Table 1 provides an overview of the studies that were included in the meta-analysis. Table 1, subdivided a through c according to the communication function (independent variable) considered, includes information concerning the authorship and date of each study, the sample size (N_i), the observed correlation between the independent and dependent variables, and reported reliability estimates (r_{xx} and/or r_{yy}) for each study. In addition, each study is characterized in terms of the three task contingencies (task structure, information requirements, and evaluation demands).

EFFECT SIZE ANALYSES OF CORRELATION COEFFICIENTS

Table 2 presents the meta-analytic results for the relationships between group decision-making effectiveness and each of the five functions examined in this study.

For the association of the first function, problem analysis, and group decision-making effectiveness, an estimated true-score correlation of .55 is found. The average r_{obs} between the two variables, weighted by sample size, is .44, with an observed standard deviation of .31. Study artifacts account for 48% of the between-study variance. For example, sampling error alone accounts for 41% of the variance in r_{obs} (not reported in Table 2). However, the standard deviation of the estimated true-score correlation is still relatively large, at .28. The 90% credibility value,

TABLE 2: Meta-Analytic Results: Zero-Order Correlation Between Group Decision-Making Effectiveness and . . .

Independent Variable	N[a]	k[b]	*Observed* r (r_{obs})	SD_r	*% Cross-Study Variance Explained*[c]	*Estimated* ρ	SD_ρ	*90% Credibility Value*[d]	*FDA*[e]
Problem analysis	191	11	.44	.31	48	.55	.28	.18	37
University lab experiments	153	9	.49	.27	59	.61	.21	.31	35
Quasi-experiments/field studies	38	2	.24	.37	38	.30	.36	–.15	3
Establishment of evaluation criteria	143	10	.21	.25	100	.27	.00	.27	11
University lab experiments	105	8	.26	.28	93	.32	.09	.19	13
Quasi-experiments/field studies	38	2	.10	.05	100	.12	.00	.12	NA
Generation of alternative solutions	143	5	.10	.20	94	.12	.06	.05	2
University lab experiments	114	4	.03	.02	100	.04	.00	.04	NA
Quasi-experiments/field studies	29	1	.38	NA	NA	NA	NA	NA	NA
Positive evaluation of solution consequences	191	11	.16	.41	35	.20	.41	–.31	7
University lab experiments	153	9	.08	.34	55	.10	.28	–.23	NA
Quasi-experiments/field studies	38	2	.64	.16	100	.79	.00	.79	11
Negative evaluation of solution consequences	125	8	.71	.29	41	.89	.27	.50	49
University lab experiments	87	6	.83	.20	76	.95	.12	.81	44
Quasi-experiments/field studies	38	2	.45	.28	52	.56	.24	.23	7

a. *N* = Total number of groups in this meta-analytic set.
b. *k* = Total number of studies or study conditions in this meta-analytic set.
c. Percentage of cross-study variance explained by the two study artifacts of sampling error and measurement error.
d. The 90% credibility value is the lower endpoint of the 90% credibility interval around .
e. FDA = File drawer analysis based on Hunter and Schmidt's technique. Number of additional, but overlooked, studies with null results needed to bring *r* down to .10.

which identifies the lower endpoint of the credibility interval around , is .18. (As explained in the Methodological Appendix, confidence intervals around population parameters such as are called *credibility intervals*. The 90% credibility value is an important indicator of the most likely smallest value of the relationship between two variables.)

The estimated true-score correlation between establishment of evaluation criteria and group effectiveness is .27. The sample-size weighted, mean observed *r* is .21, with a variance of .06. In this case, all observed score variance is explained by artifacts. Consequently, SD_ρ is 0 and the 90% credibility value has the same value as , .27.

The third function, generation of solution alternatives, shows an average estimated true-score correlation with effectiveness of .12. The sample-size weighted, mean observed correlation r_{obs} is .10, with a variance of .04. Artifacts account for 94% of between-study variance in r_{obs}, with 93% being solely attributable to sampling error (not reported in Table 2). The standard deviation of the estimated true-score correlation is .06, and the 90% credibility value is .05.

The fully corrected, average correlation between evaluation of positive consequences of alternative solutions and group effectiveness is .20, with a large standard deviation of .41. The sample-size weighted, mean observed *r* between the two variables is .16, with a variance of .17. In this case, artifacts account for only 35% of observed variance; hence, a large residual standard deviation was left (.34; not reported in Table 2). The 90% credibility value is negative at –.31.

Unlike the previous function, evaluation of negative consequences of solution alternatives is on the average highly correlated with group effectiveness (r_{obs} = .71; estimated true-score = .89). Artifacts account for 41% of observed variance (.08). The standard deviation of the estimated true-score correlation is found to be .27, and the 90% credibility value is .50.

FILE DRAWER ANALYSIS

Computations, using the FDA described above, show that about 37 additional primary studies averaging null findings would have to be found for problem analysis to bring the mean r_{obs} down to .10 (Table 2). For establishment of solution criteria, this figure is 11; for generation of solution alternatives, it is 2. And 7 and 49 additional studies would have to be located for assessment of positive solution attributes and negative solution attributes, respectively. Thus, the FDA shows that for one function, generation of solution alternatives, a very small number of studies might change the conclusions of this meta-analysis. For the other communication functions, however, it is unlikely that so many studies were overlooked, given the newness of the theory and research area. Thus, with respect to four of the five functions, we can be reasonably confident that availability bias did not have much impact on the results of the present meta-analysis.

MODERATOR ANALYSIS

There are two methods that can be used to detect the existence of any (unsuspected) moderators. First is the 75% rule: If 75% or more of the observed variance of r_{obs} across studies is due to artifacts, then probably all of it is artifactual variance, on the grounds that the remaining 25% or less is likely to be due to artifacts not corrected for, such as reporting or transcription error, lack of construct validity, or range restriction (Hunter & Schmidt, 1990a). Thus, in cases where 75% or more of variance is accounted for by study artifacts, including sampling error variance, moderators are unlikely to have caused a "real" cross-study variation in *r*. The 75% rule has been shown to be a good one for small sample research designs (McDaniel & Hirsh, 1986, as cited in Hunter & Schmidt, 1990a, p. 440), which is the case in the present meta-analysis. The 75% rule would suggest that in the case of problem analysis (48% variance accounted for), evaluation of positive consequences of alternative solutions (35%), and evaluation of negative consequences of alternative solutions (41%), moderators (i.e., contingency variables or interaction effects) exist (see Table 2).[4]

An alternative method is available for detecting theoretically predicted moderators. Moderator analyses are conducted by separating the overall meta-analytic set of studies into relevant subgroups, namely study domain subsets according to task contingencies. The comparison of effect sizes (r_{obs} and ρ in this case) can be used for inferences concerning task moderators. The important questions to ask in this second type of moderator analysis are as follows: (a) Do the observed (r_{obs}) and true-score correlation (ρ) estimates differ in the different task moderator subsets? (b) Are the percentages of cross-study variance explained higher in the study domain subsets than in the overall meta-analytic set? (c) In the moderator subgroups, does the percentage of cross-study variance explained approach the 75% threshold that was described above? If the answer to these three questions is yes, a moderator has been detected.

Study design. Before proceeding to the explicit consideration of Hypotheses 1a through 1c, the examination of possible study design moderators may be of interest. For this purpose, Table 2 also shows the entire meta-analytic data set subdivided into (a) university lab experiments and (b) quasi-experiments or correlational studies. Generally, lab experiments found greater (observed and estimated true score) effects than did field studies for problem analysis, establishment of evaluation criteria, and negative evaluation of solution consequences, whereas the opposite is true for the remaining two functions. In most cases, the percentage of cross-study variance explained by sampling error and measurement error is greater in the subgroups than in the aggregated groups. Therefore, to varying degrees, study design accounts for some of the cross-study variance (i.e., acts as a moderator).

Task moderators. Table 3 presents a summary of the moderator analysis suggested by Hypotheses 1a through 1c. With respect to problem analysis, the moderator analysis suggests that task struc-

TABLE 3: Moderator Analysis: Nature of Group Task

Task Contingency	k	N	*Observed* r (r_{obs})	*% Variance Explained*[a]	*Estimated* ρ	SD_ρ
a: Problem analysis						
High/simple TS	7	91	.42	58	.52	.26
Low/complex TS	4	100	.46	38	.57	.28
Low IR	8	139	.49	54	.61	.24
High IR	3	52	.31	46	.38	.31
Low ED	6	82	.37	69	.46	.21
High ED	5	109	.50	38	.62	.30
b: Evaluation of positive consequences of alternative solutions						
Low ED	6	82	.21	36	.26	.45
High ED	5	109	.12	33	.15	.38
Simple TS	7	91	.28	32	.35	.49
Complex TS	4	100	.05	45	.06	.28
Low IR	8	139	.28	36	.35	.38
High IR	3	52	–.18	86	–.23	.12
c: Evaluation of negative consequences of alternative solutions						
Low ED	5	58	.48	92	.59	.09
High ED	3	67	.92	100	1.00	.00
Simple TS	6	67	.54	67	.67	.21
Complex TS	2	58	.91	100	1.00	.00
Low IR	7	115	.70	39	.87	.28
High IR	1	10	.89	NA	NA	NA

NOTE: *k* = number of studies; *N* = total number of groups; TS = task structure; IR = information requirements; ED = evaluation demand.
a. Percentage of cross-study variance of observed *r* explained by study artifacts (i.e., sampling error and measurement error).

ture is not the moderator of the correlation between problem analysis and group effectiveness. For simple tasks (i.e., tasks high in structure), the estimated true-score correlation was .52, whereas for complex tasks low in structure the correlation was .57. Although the difference is in the predicted direction, the credibility intervals of the estimated true-score correlations overlap. The percentage of variance accounted for by study artifacts is higher than that for the entire domain (48%; see Table 2) in one subset (58%; studies with high task structure) but lower in the other (38%). Furthermore, although we fail to confirm information requirements as a moderator in the expected direction, evaluation demand works slightly better as an explanation for cross-study variance with respect to problem analysis. However, for all three potential task moderators of problem analysis, the cross-study variance explained by artifacts remains below the 75% threshold.

In addition, evaluation demands do not seem to moderate the effect of evaluation of positive consequences of alternative solutions on group decision-making effectiveness. The estimated true-score correlations were .26 in the case of low evaluation demand and .15 for high evaluation demand and, thus, even in the opposite direction than that hypothesized by Hirokawa (1990). The proportion of variance explained by study artifacts is very close to the 35% observed in the entire meta-analytic domain of studies (36% and 33%, respectively). If at all, task structure and information requirements also work in the direction opposite from the one expected.

However, evaluation demands appear to be moderating the effects of assessment of negative consequences of alternative solutions. With tasks low in evaluation demands, the observed correlation is .48, whereas for tasks high in evaluation demand, the observed correlation is .92. The artifact distribution meta-analysis in the second subset (high evaluation demand, $k = 3$) overcorrected for attenuation effects, resulting in an estimate of = 1.00 (Table 3c). The percentage of variance accounted for is 92% in the subset of studies with tasks low in evaluation demand. Therefore, as in the other subset (tasks high in evaluation demand), it is much greater than the percentage of variance accounted for in the overall meta-analysis for negative assessment (41%). Thus, evaluation demands in fact interact with the function of evaluation of negative consequences of alternative solutions, as was predicted by Hirokawa (1990). Task structure and information requirements also work in the expected direction, but the explanatory power (percentage of cross-study variance explained in moderator subgroups) is slightly lower than that of evaluation demand.

EMPIRICAL SUPPORT FOR HYPOTHESES

The comparison of Tables 2 and 3 suggests that Hypotheses 1a and 1b receive generally weak or moderate empirical support in this meta-analysis, whereas Hypothesis 1c receives strong support for negative evaluation of solutions. Empirical support for Hypothesis 1a (task structure or complexity) is stronger for the communication function of evaluation of negative consequences of alternative solutions than the other two communication functions considered in Table 3. For problem analysis, the moderator effect of task structure is in the hypothesized direction but fails to reach significance. The empirical support for the moderator of information requirements (Hypothesis 1b) is consistently weak across the different communication function subgroups in Table 3. With respect to Hypothesis 1c, evaluation demands seem to work opposite the expected effect for positive evaluation of solutions but are highly consistent with Hirokawa's (1990) theoretical expectations with respect to negative evaluation of solutions. For problem analysis, evaluation demand is of only moderate explanatory power. As shown in Table 2 and discussed above, additional explanatory power is added by the consideration of study design as a potential moderator.

The study artifacts of sampling error and measurement error account for 100% and 94% of cross-study variance for establishment of solution criteria and generation of solutions, respectively. Hence, for these two communication functions, Hypothesis 2 receives strong empirical support. Therefore, no further moderator analyses were conducted for these two subsets. For the other three communication functions, the 75% variance threshold was not reached. Therefore, moderator investigations were deemed necessary (as shown in Table 3 and discussed above).

DISCUSSION

Our meta-analysis of empirical research testing the functional theory of small-group decision-making effectiveness shows that, across different study contexts, the most important process function is group members' assessment of negative consequences of alternative solutions (observed mean correlation of .71; estimated true-score correlation of .89, see Table 2). This finding provides convincing support for Janis's emphasis on the necessity of critical evaluators in a group (Janis, 1982). Janis argued that, based on his (mostly qualitative) analysis of policy decisions (e.g., Herek, Janis, & Huth, 1987), small groups need someone who points out the potential disadvantages of proposed solutions or decisions. Janis and his associates usually call this person a *critical evaluator.* Arguments for the benefits of devil's advocacy and dialectical inquiry in small-group decision making have been in a similar vein (Valacich & Schwenk, 1995). However, the effect of this communication function seems to be moderated by evaluation demand, one of the three task contingencies (see Table 3c). Assessment of negative consequences appears to be more important (observed r of .92) for equivocal tasks (multiple acceptable choices, nonobvious criteria, objective nonverifiability) than for unequivocal tasks (observed r of .48; see Table 3c). This cross-study meta-analytic finding confirms the arguments and empirical evidence presented by Jehn and Shah (1997).

Other important communication functions are problem analysis (assessment of the question, task demands, or context) with an estimated true-score correlation of .55 and the establishment of evaluation criteria by group members with an estimated true-score correlation of .27 (see Table 2). Although the former relationship is likely to be affected by one or more moderators, criteria development is consistently important across situational contingencies (artifacts, including sampling error, accounted for all of the cross-study variance in r_{obs}). What remains to be developed theoretically and studied empirically is the nature of the moderator-impacting problem analysis. Although the meta-analysis suggests that task structure is probably not the moderator variable, evaluation demand is more likely to explain cross-study variability than task structure or information requirements.

Somewhat surprising is the finding that the generation of alternative solutions is related to group effectiveness to only a very limited extent (estimated mean true-score correlation = .12) across studies. Hence, the time spent on brainstorming decision alternatives seems to be the least important of all five functions examined in the meta-analysis because the number of alternatives does not explain or predict group decision-making effectiveness. Our meta-analysis suggests that brainstorming may have a smaller effect on group performance than has generally been assumed in the small-group literature (e.g., Jarboe, 1996), although it may work well with “real world” bona-fide groups (see Table 2; Sutton & Hargadon, 1996).

The implicit danger with brainstorming could lie in its potential trade-off of the group’s time spent on the four other functions. Generation of solution alternatives, when considered in conjunction with other task-relevant communication functions, might detract from group decision-making effectiveness because group members’ resources are not being invested in the other functions that aid the group decision-making process. A possible reason for the disadvantage of allocating time to nonjudgmental brainstorming might lie in group work removal from critical positive and negative solution consequences. In other words, groups might substitute quantity for quality of solution alternatives if the generation of solutions is overemphasized by a group facilitator.

Although evaluation of positive consequences of alternative solutions was not as highly correlated with group decision-making effectiveness as was problem analysis (true-score correlation estimates: .20 vs. .55; see Table 2), it shares with the other function the necessity for a search for moderator variables. For positive evaluation, task contingencies seem to be insufficient to account for the cross-study variability of estimated mean observed and true-score correlations. Other moderators need to be identified, because it is unlikely that other artifacts that have not been corrected for account for the remaining 65% of the variance. In other words, communication scholars need to specify, theoretically and empirically, the set of circumstances that would make the evaluation of the positive consequences of alternative solutions especially important. Evaluation demands appear to have a quite different impact on this function than on assessment of negative solution attributes. Although our meta-analysis answers a lot of the previous questions in the small-group communication literature, the function of positive evaluation remains somewhat of a puzzle, as the impact of the moderators tended to be in the direction opposite from the one anticipated from theory.

Future meta-analyses should take into account other communication functions as well. Two functions whose correlations with group effectiveness could be examined in future research are establishment of operating procedures and socioemotional talk. In studies using the functional perspective, both of those functions have been shown to detract from group performance.[5] Future meta-analytic research needs to demonstrate that this is also the case using a larger set of studies.

The next step to be taken in this research program must be the theoretical specification of nontask moderators that are likely to impact the effect of problem analysis and evaluation of positive consequences of alternative solutions on group decision-making effectiveness. Contingencies may be found in social settings, surrounding organizational structure, organizational culture, group cohesion, and national culture. These postulated moderators could then be tested in primary studies and ultimately confirmed (or disconfirmed) in a new meta-analysis.

Due to the dearth of correlations between generation of solution alternatives and group effectiveness, more primary studies should be conducted on this particular task-related function and then aggregated in a meta-analysis. This future research might show that the relatively low true-score correlation found in this study is not simply due to second-order sampling error. Second-order sampling error can still remain in meta-analyses correcting for (first-order) sampling error in primary studies, if the number of aggregated correlation coefficients (k; see Tables 2 and 3) is small. Sampling error in the meta-analytic estimates of mean correlations and their standard deviations are called second-order sampling error. Our reluctance to be overly inclusive with respect to operationalization of communication functions may explain some of this second-order sampling error. In other words, we traded external validity of our meta-analytic sample for operational comparability of communication functions (and thus construct validity) (Bangert-Drowns, 1986).

Despite these limitations, the present meta-analysis provides empirical support for the functional theory of group decision-making effectiveness—for some task-communication functions more than for others. It suggests the importance of group communication concerning negative decision attributes, especially in the case of equivocal tasks, and the importance of thorough problem analysis. Based on our meta-analysis, the communication processes that managers and supervisors ought to emphasize most are assessment of negative solution attributes and thorough understanding and analysis of the task. Thus, on one hand, we emphasize the importance of negative evaluation of solution alternatives. On the other hand, however, group members ought not to forget that negativity in general, or personally disconfirmatory messages more specifically, may be unproductive (Mabry & Attridge, 1990).

METHODOLOGICAL APPENDIX

This methodological appendix explains and justifies the statistical conventions used in the meta-analysis.

Pearson's product-moment correlation (PM *r*) was chosen as effect size metric in this study. This choice was made based on the finding that most data points were available in this form. For the purpose of study interpretation, reporting PM *r*s seems to be most reasonable in the present case in which the task was to find those group communication functions that best predict small-group decision-making effectiveness. Because the number and nature of predictors tended to vary from one study to the next, multiple regression weights as reported by primary studies cannot be used for the meta-analysis (see Hunter & Schmidt, 1990a, pp. 203-205, 502-503). Thus, the disadvantages of raw score, and standardized, multiple regression weights also suggest Pearson's *r* as the most appropriate effect size to be meta-analyzed.

The meta-analysis relied on Hunter & Schmidt's (1990a) statistical aggregation techniques for cumulating correlations and correcting for various artifacts. Study artifacts, such as sampling error and measurement error, can distort or attenuate observed correlations. Through the use of

Hunter and Schmidt's meta-analytic techniques, one can make corrections to obtain a true-score correlation ( ) between the communication functions and small-group effectiveness. Because not all artifact data points were available for each study (see Table 1), correlations could not be corrected individually for artifacts. Instead, the meta-analysis corrected correlation coefficients by using artifact distributions. Artifact-distribution meta-analysis involves first computing the means and variances of reported correlations and of the considered artifacts (e.g., reliability of independent variable, reliability of dependent variable, and range variation). Then, the distribution of observed correlations is corrected for sampling error. Finally, the distribution corrected for sampling error is corrected for error of measurement (Hunter & Schmidt, 1990a). Further technical details with regard to the correction factors used for reported correlations and their variances are presented and derived in Hunter and Schmidt (1990a, pp. 160-173).

Schmidt's computer program INTNL, using artifact distributions, was employed in running the meta-analyses. The program corrects for such artifacts as unreliability in the independent and dependent variables and range variation. The latter correction was not used because there was insufficient information to quantify range variation in the samples. INTNL uses an interactive formula for the computation of true-score variance (^{2}) (see Hunter & Schmidt, 1990a, p. 186). The procedure allows for the simultaneous, rather than sequential, computation of variances attributable to cross-study differences in range restriction and reliability of the dependent and independent variables (Hunter & Schmidt, 1990a, p. 186).

The meta-analysis software includes no significance tests because statistical significance testing has been argued to stunt the growth of scientific knowledge (Cohen, 1994; Hunter & Schmidt, 1990a, pp. 29-31, 112, 440-450, 483; Schmidt, 1996). Instead, point estimates are reported and credibility intervals around are constructed. Confidence intervals that use information corrected for study artifacts are called *credibility intervals*.

NOTES

1. Gouran and Hirokawa (1996) present the most current version of the functional theory applied to group decision-making effectiveness.

2. See Gouran, Hirokawa, Julian, and Leatham (1993) for a review of three possible methodological weaknesses, namely coding difficulties, study time constraints, and lack of experimental control, which may account for inconsistencies across studies.

3. Such estimates are often referred to as conspect, or scorer, reliability and, in general, fail to take into account three sources of measurement error: purely random response error, specific error, and transient error (Schmidt & Hunter, 1996). The neglect of inclusion of these three error sources leads to an overestimation of reliability and, thus, to an undercorrection of the observed correlations. Therefore, our computed true-score correlations are conservative estimates. True-score correlation may in fact be higher than those reported in this meta-analysis.

4. A second method to look for unsuspected moderators is the chi-square test for homogeneity. Although this test has lower power for detecting moderators than the 75% rule (Hunter & Schmidt, 1990a, p. 440), it is commonly recommended and used. The homogeneity chi-square test uses the test statistic *Q*, which is defined as k^* Var(r)/Var(e), where k is the number of studies and Var(e) is the error variance of r. *Q* is distributed as chi-square with $k - 1$ degrees of freedom. The computations of *Q* for all five communication functions would suggest moderator variables for the same three functions as the 75% rule: problem analysis (*Q* of 23.08), evaluation of positive consequences of alternative solutions (*Q* of 31.90), and evaluation of negative consequences of alternative solutions (*Q* of 19.66). The other two *Q* homogeneity test statistics were nonsignificant (9.19 for establishment of solution criteria, 5.32 for generation of solution alternatives). In sum, both the 75% rule and the *Q* test statistic lead to the same conclusion that there are one or more moderators for the effects of problem analysis and evaluation of positive and negative consequences on group decision-making effectiveness.

5. We also meta-analyzed correlations for these two functions: establishment of operational procedures, which is another task function, and socio-emotional talk (communication that brings about bonding among group members and group cohesiveness). The number of correlations found in the present studies ($k = 3$ and 4, respectively) were too low as to allow for sound theoretical conclusions to be drawn. In other words, this set of studies testing Hirokawa's functional theory probably does not accurately reflect the whole population of studies with respect to these two other functions. What was found in this set was that both the establishment of operational procedures (estimated true-score correlation of –.48, 53% of variance accounted for by artifacts) and socioemotional talk (estimated true-score correlation of –.23 with 100% of cross-study variance accounted for and, thus, a standard deviation of 0) were negatively related to group decision-making effectiveness.

REFERENCES

Algera, J. A., Jansen, P.G.W., Roe, R. A., & Vijn, P. (1984). Validity generalization: Some critical remarks on the Schmidt-Hunter procedure. *Journal of Occupational Psychology*, *57*, 197-210.

Bales, R. F. (1950). *Interaction process analysis*. Reading, MA: Addison-Wesley.

Bales, R. F. (1953). The equilibrium problem in small groups. In T. Parsons, R. F. Bales, & E. A. Shils (Eds.), *Working papers in the theory of action* (pp. 111-161). Glencoe, IL: Free Press.

Bangert-Drowns, R. L. (1986). Review of developments in meta-analytic method. *Psychological Bulletin*, *99*, 388-399.

Cohen, J. (1994). The earth is round ($p < .05$). *American Psychologist*, *49*, 997-1003.

Collins, B. E., & Guetzkow, H. (1964). *A social psychology of group processes for decision-making*. New York: John Wiley.

Cooper, H. M. (1989). *Integrating research: A guide for literature reviews* (2nd ed.). Newbury Park, CA: Sage.

Cragan, J. W., & Wright, D. W. (1990). Small group communication research of the 1980s: A synthesis and critique. *Communication Studies*, *41*, 212-236.

Cragan, J. W., & Wright, D. W. (1993). The functional theory of small group decision-making: A replication. *Journal of Social Behavior and Personality*, *8*, 165-174.

Dewey, J. (1910). *How we think*. Boston: Heath.

Ebel, R. L. (1951). Estimation of the reliability of ratings. *Psychometrika*, *16*, 407-424.

Gouran, D. S. (1991). Rational approaches to decision-making and problem-solving discussion. *Quarterly Journal of Speech*, *77*, 343-358.

Gouran, D. S., & Hirokawa, R. Y. (1983). The role of communication in decision-making groups: A functional perspective. In M. S. Mander (Ed.), *Communications in transition* (pp. 168-185). New York: Praeger.

Gouran, D. S., & Hirokawa, R. Y. (1986). The counteractive functions of communication in effective group decision-making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision-making* (pp. 81-90). Beverly Hills, CA: Sage.

Gouran, D. S., & Hirokawa, R. Y. (1996). Functional theory and communication in decision-making and problem-solving groups: An expanded view. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision-making* (2nd ed., pp. 55-80). Thousand Oaks, CA: Sage.

Gouran, D. S., Hirokawa, R. Y., Julian, K. M., & Leatham, G. B. (1993). The evolution and current status of the functional perspective on communication in decision-making and problem-solving groups: A critical analysis. *Communication Yearbook*, *16*, 573-600.

Graham, E. E., Papa, M. J., & McPherson, M. B. (in press). An applied test of the functional communication perspective of small group decision-making. *Southern Communication Journal*.

Guetzkow, H. (1950). Unitizing and categorizing problems in coding qualitative data. *Journal of Clinical Psychology*, *6*, 47-58.

Hackman, J. R., & Morris, C. G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 8, pp. 45-99). New York: Academic Press.

Herek, G., Janis, I. L., & Huth, P. (1987). Decision making during international crises: Is quality of process related to outcome? *Journal of Conflict Resolution*, *31*, 203-226.

Hirokawa, R. Y. (1980a). *A function-oriented analysis of small group interaction within effective and ineffective decision-making groups: An exploratory investigation*. Unpublished dissertation, University of Washington, Department of Speech Communication.

Hirokawa, R. Y. (1980b). A comparative analysis of communication patterns within effective and ineffective decision-making groups. *Communication Monographs*, *47*, 312-321.

Hirokawa, R. Y. (1982). Group communication and problem-solving effectiveness I: A critical review of inconsistent findings. *Communication Quarterly*, *30*, 134-141.

Hirokawa, R. Y. (1983). Group communication and problem-solving effectiveness II: An exploratory investigation of procedural functions. *Western Journal of Speech Communication*, *47*, 59-74.

Hirokawa, R. Y. (1985). Discussion procedures and decision-making performance: A test of a functional perspective. *Human Communication Research*, *12*, 203-224.

Hirokawa, R. Y. (1987). Group communication research: Considerations for the use of interaction analysis. In C. H. Tardy (Ed.), *A handbook for the study of human communication* (pp. 229-245). Norwood, NJ: Ablex.

Hirokawa, R. Y. (1988). Group communication and decision-making performance: A continued test of the functional perspective. *Human Communication Research*, *14*, 487-515.

Hirokawa, R. Y. (1990). The role of communication in group decision-making efficacy: A task-contingency perspective. *Small Group Research*, *21*, 190-204.

Hirokawa, R. Y. (1996). Communication and group decision-making effectiveness. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision-making* (2nd ed., pp. 269-297). Thousand Oaks, CA: Sage.

Hirokawa, R. Y., Oetzel, J. G., Aleman, C. G., & Elston, S. E. (1994). *The effects of evaluation clarity and bias on the relationship between vigilant interaction and group decision-making efficacy.* Unpublished manuscript.

Hirokawa, R. Y., & Rost, K. M. (1992). Effective group decision making in organizations: Field test of the vigilant interaction theory. *Management Communication Quarterly*, *5*, 267-288.

Hunter, J. E., & Schmidt, F. L. (1990a). *Methods of meta-analysis: Correcting error and bias in research findings*. Newbury Park, CA: Sage.

Hunter, J. E., & Schmidt, F. L. (1990b). Dichotomization of continuous variables: The implications for meta-analysis. *Journal of Applied Psychology*, *75*, 334-349.

Janis, I. L. (1972). *Victims of groupthink*. Boston: Houghton Mifflin.

Janis, I. L. (1982). *Victims of groupthink* (2nd ed.). New York: Houghton Mifflin.

Janis, I. L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment*. New York: Free Press.

Jarboe, S. (1996). Procedures for enhancing group decision making. In R. Y. Hirokawa & M. S. Poole (Eds.), *Communication and group decision-making* (pp. 345-383). Thousand Oaks, CA: Sage.

Jehn, K. A., & Shah, P. P. (1997). Interpersonal relationships and task performance: An examination of mediation processes in friendship and acquaintance groups. *Journal of Personality and Social Psychology*, *72*, 775-790.

Mabry, E. A., & Attridge, M. D. (1990). Small group interaction and outcome correlates for structured and unstructured tasks. *Small Group Research*, *21*, 315-332.

McDaniel, M. A., & Hirsh, H. R. (1986, April). *Methods of moderator detection in meta-analysis. An overview and new directions in the Hunter-Schmidt-Jackson meta-analysis technique*. Symposium presented at the Annual Conference of the Society for Industrial/Organizational Psychology, Chicago.

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

Nakanishi, M. (1990, November). *Group communication and decision-making effectiveness: A test of the functional perspective*. Paper presented at the meeting of the Speech Communication Association, Chicago.

Pavitt, C. (1994). Theoretical commitments presupposed by functional approaches to group discussion. *Small Group Research*, *25*, 520-541.

Presby, S. (1978). Overly broad categories obscure important differences between therapies. *American Psychologist*, *33*, 514-515.

Propp, K. M., & Nelson, D. (1995). *Decision-making performance in naturalistic groups: A test of the ecological validity of the functional perspective*. Unpublished manuscript.

Rosenthal, R. (1979). The "file drawer problem" and tolerance for null results. *Psychological Bulletin*, *86*, 638-641.

Schmidt, F. L. (1996). Statistical significance testing and cumulative knowledge in psychology: Implications for training of researchers. *Psychological Methods*, *1*, 115-129.

Schmidt, F. L., & Hunter, J. E. (1996). Measurement error in psychological research: Lessons from 26 research scenarios. *Psychological Methods*, *1*, 199-223.

Steiner, I. D. (1972). *Group process and productivity.* New York: Academic Press.

Sutton, R. I., & Hargadon, A. (1996). Brainstorming groups in context: Effectiveness in a product design firm. *Administrative Science Quarterly*, *41*, 685-718.

Valacich, J. S., & Schwenk, C. (1995). Devil's advocate and dialectical inquiry effects on face-to-face and computer-mediated group decision making. *Organizational Behavior and Human Decision Processes*, *63*, 158-173.

Marc Orlitzky, Ph.D., recently joined the Australian Graduate School of Management as a faculty member after receiving a doctoral degree in business administration from the University of Iowa.

Randy Y. Hirokawa is a professor in the department of communication studies at the University of Iowa.