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Collective Efficacy, Group Potency, and Group Performance: Meta-Analyses of Their Relationships, and Test of a Mediation Model

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The authors examined relationships among collective efficacy, group potency, and group performance. Meta-analytic results (based on 6,128 groups, 31,019 individuals, 118 correlations adjusted for dependence, and 96 studies) reveal that collective efficacy was significantly related to group performance (.35). In the proposed nested 2-level model, collective efficacy assessment (aggregation and group discussion) was tested as the 1st-level moderator. It showed significantly different average correlations with group performance (.32 vs. .45), but the group discussion assessment was homogeneous, whereas the aggregation assessment was heterogeneous. Consequently, there was no 2nd-level moderation for the group discussion, and heterogeneity in the aggregation group was accounted for by the 2nd-level moderator, task interdependence (high, moderate, and low levels were significant; the higher the level, the stronger the relationship). The 2nd and 3rd meta-analyses indicated that group potency was related to group performance (.29) and to collective efficacy (.65). When tested in a structural equation modeling analysis based on meta-analytic findings, collective efficacy fully mediated the relationship between group potency and group performance. The authors suggest future research and convert their findings to a probability of success index to help facilitate practice.

Keywords: collective efficacy, group potency, group performance, meta-analysis, structural equation modeling

Bandura (1982) introduced collective efficacy ("a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments"; Bandura, 1997, p. 447) as a part of social cognitive theory's extension to group level of analysis. Research has since supported its positive relationship with various outcomes in organizational, educational, sports, and military settings (Bandura, 2000; George & Feltz, 1995; Zaccaro, Blair, Peterson, Zazanis, 1995). In work-related contexts, collective efficacy has been related to group problem solving (Kline & MacLeod, 1997), group learning (Edmondson, 1999), as well as performance in service (Gibson, 1999), manufacturing (Little & Madigan, 1997), and simulated settings (Gibson, Randel, & Earley, 2000). A meta-analysis also found that collective efficacy is related to group performance (Gully, Incalcaterra, Joshi, & Beaubien, 2002).

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The purpose of this study is to provide a thorough, comprehensive and up to date meta-analytic synthesis of the relationships among collective efficacy, group potency (a generalized version of collective efficacy), and group performance. The key differences between the past review (Gully et al., 2002) and the present work include the following: (a) many more studies examined (increase of 60% in the number of studies and 66% in the number of correlations), (b) broader scope of studies included (e.g., experimental studies are included in our analyses), (c) different methods/analyses (e.g., we conduct nested moderator analysis, test within- and between-groups homogeneities, and examine a new multivariate mediation model), and (d) different results and conclusions obtained. These differences are elaborated in more (numerical) detail in the Results and Discussion sections.

Collective Efficacy–Group Performance Relationship

The relationship between collective efficacy and group performance is described in detail elsewhere (Bandura, 1997), and we summarize it briefly. According to social cognitive theory, "the higher the sense of collective efficacy, the better the team performance" (Bandura, 1997, p. 470). A group's belief that it can handle certain tasks is important because collective efficacy, a task- and context-specific variable, influences a group to initiate action, how much effort the group will exert, and how long the group's effort will be sustained. Thus, we hypothesize the following:

Hypothesis 1: There is a positive average correlation between collective efficacy and group performance when individual findings from available studies are meta-analyzed.

Collective Efficacy Assessment—First-Level Moderator

When group members rely on one another for performance, one question is how to most appropriately capture a group's collective efficacy. We propose that a key initial moderator of the relationship between collective efficacy and group performance is how collective efficacy is assessed. As Bandura (1997) has stated, "Progress in this [collective efficacy] field of study requires the development of suitable tools for measuring groups' shared beliefs of efficacy to achieve varying levels of results" (p. 478).

Research has offered two collective efficacy assessment methods: (a) group discussion and (b) aggregating each member's appraisal of the groups' capability (Bandura, 1997; Gibson et al., 2000). Each of the two methods received support and criticism around two questions: (a) Which is more appropriate for capturing a group's shared efficacy beliefs and thus is more congruent with performance at a group level? and (b) Which better avoids social influences associated with accessing a group's shared beliefs and thus more accurately relates to group performance?

Assessment Through Group Discussion

In this method, members discuss their group's perceived collective efficacy. After the group discussion, they settle on a single assessment. This measure is readily congruent (no need for aggregation) with the group level of performance. If potential social/power influences (discussed next) are dealt with, group discussion may reveal group strengths/weaknesses previously unknown to each group member.

Although recognizing its strengths, Bandura (1997) suggests that group discussion placed in the daily reality of work is prone to potential weaknesses. The concern is that group discussion can turn into a social influence event (for discussion of social conformity in groups, see Asch, 1956; Earley, 1999) rather than an unbiased, collegial assessment procedure. If the former occurs, the method of assessment may change the phenomena being assessed (Bandura, 1997). Simply, members of a group likely differ in their competencies, roles, aspirations, and statures; yet, group discussion needs to result in a single collective efficacy assessment. A single estimate of collective efficacy may be subject to persuasory efforts to reach a consensus by members with power and influence and, thus, may mask the true variability in beliefs among group members. Of the collective efficacy–group performance estimates that we analyzed, 18% were based on this method of collective efficacy assessment. None of the articles that provided these estimates reported social influence concerns (and, thus, we cannot tell/measure whether they existed).

Aggregation of Individual Assessment

In this method, each group member considers his/her perception of the collective efficacy of the group. The assessment is made individually and privately, data are collected from each member, and these assessments are then aggregated into one assessment at the group level of analysis so it matches the group level of performance. The variability in beliefs among group members may be masked in this method as well if the variability of individual ratings is not factored into the group assessment.

Bandura (1997) has suggested, and we agree, that this is the preferred way of assessing collective efficacy because it avoids the social influence biases associated with the group discussion. Others disagree by questioning whether this method (being individually based) could capture *shared* group beliefs (Guzzo, Yost, & Shea, 1993). Bandura (1986, 2000) has noted that this question may be largely due to the meaning and definition of the term shared. That is, social cognitive theory emphasizes that there is no physical entity such as a group mind, and it cannot be considered/measured (for it is metaphysical) for its level of shared belief (Bandura, 2000). Thus, even though collective efficacy is a group-level property, minds of the individual members who make up the group are the locus of collective efficacy assessment. Of the collective efficacy–group performance estimates analyzed, 82% were based on this assessment.

Each of the two assessments that we discussed has proponents and opponents, advantages and disadvantages, and evidence of its use and predictive powers. Thus, we hypothesize the following:

Hypothesis 2: The collective efficacy–group performance relationship is moderated by collective efficacy assessment.

Task Interdependence—Second-Level Moderator

Differences in magnitudes of the relationship between collective efficacy and group performance can also arise because of the differences in level of task interdependence among group members (Bandura, 1997; Gibson, 1999; Saavedra, Earley, & Van Dyne, 1993). Although task interdependence (the extent to which a task requires group members to interact; Thompson, 1967) is often the precondition for groups to be formed in the first place (Van de Ven, Delbecq, & Koening, 1976), various levels of it may produce different patterns of interactions among group members (Wageman, 1995). The greater the interconnections among the group members in terms of tasks that they need to do, the greater the requirements for their fruitful cooperation (Kelley & McGrath, 1985; Kiggundu, 1981, 1983; Slocum & Sims, 1980; Steiner, 1972).

At a low interdependence task, the group's level of performance is the sum of outcomes produced, largely, independently. Because they do not need to rely much on one another to perform their job, there is less need to share information about the skills and resources required for successful performance. In such an endeavor, group members are likely to develop their own individual judgment and knowledge structure about the given tasks (Wageman, 1995).

A high interdependence task requires frequent interaction among group members to accomplish performance results (e.g., a basketball team). Through ongoing adjustments to one another's performance, group members can assess what skills and abilities the group as a whole needs for successful performance. Because high interdependence tasks require group members to work together to perform well, separating one's own functioning from that of the group becomes difficult (Lindsley, Brass, & Thomas, 1995). As a result, collective efficacy built through interaction and joint effort of group members on a high interdependence task is likely

to be more strongly related to group's performance than on a low interdependence task. Thus, we hypothesize the following:

> *Hypothesis 3:* The collective efficacy–group performance relationship is moderated by task interdependence: the higher the task interdependence, the stronger the relationship between collective efficacy and performance for each collective efficacy assessment.

Relationships Among Collective Efficacy, Group Potency, and Group Performance

Ambiguity is found regarding the properties of group potency in comparison with collective efficacy. Although intended as a general (trait-like) group attribute, some define group potency about the same as collective efficacy (Shea & Guzzo, 1987a), some hardly acknowledge it (Bandura, 1997), and some differentiate group potency theoretically from collective efficacy and separate them empirically in some analyses and combine them in others (Gully et al., 2002). Adding to ambiguities is the lack of research that examines the potential links between collective efficacy and group potency. To address some of these ambiguities, we compare definitions of group potency and collective efficacy, identify differences, and propose a mediation model.

Definitions and Comparisons

In Table 1, we list 10 definitions of group potency and 10 comparisons of group potency and collective efficacy (all 20 are quotes). Earliest definitions of group potency (from late 1980s, early 1990s) do not appear helpful in explicating its general nature; to us, they closely resemble definitions of collective efficacy. Definition ambiguities of group potency began to clarify circa mid-1990s, when authors started to include in definitions specific defining attributes of group potency, for example, ". . . broader perceptions . . . spanning task and situations" (Gully et al., 2002, p. 819), "*any* task or demand" (Zaccaro et al., 1995, p. 309), and "across situations" (Lindsley, Mathieu, Heffner, & Brass, 1994, p. 1). Since then, it appears clear(er) that group potency shall be considered as a general characteristic regarding a group's enduring ability to perform a wide range of tasks across different activities.

Group Potency and Group Performance

A number of studies have shown a positive relationship between group potency and performance. On the basis of that research, we hypothesize the following:

> *Hypothesis 4:* There is a positive average correlation between group potency and group performance when individual findings from available studies are meta-analyzed.

Key Difference Between Group Potency and Collective Efficacy

On the basis of the review we reported, group potency is a generalized variable helpful to "*any* task or demand [a group] may confront" (Zaccaro et al., 1995, p. 314). Collective efficacy is linked to specific activity domains (Bandura, 1997). Group potency is assessed by several global items (e.g., "No task is too tough for this team"; Guzzo et al., 1993, p. 98), and collective efficacy measures are tailored to the topic studied (e.g., collective efficacy of teachers vs. military combat units). Research at an individual level shows that efficacy measures tailored to the activity domain are more predictive than global "one-size-fits-all" ones (Bandura, 2006). Because the latter are vague as to the activity domain to which they apply, Bandura (1997, see p. 41) has recommended against using them. Therefore, we hypothesize the following:

> *Hypothesis 5:* There is a higher average correlation between collective efficacy and group performance than average correlation between group potency and group performance.

Proposed Mediation Model

The mechanism through which group potency and collective efficacy may be related to each other in influencing group performance has not been specified in past research. On the basis of our discussion regarding the general nature of group potency and more domain-specific collective efficacy, we propose that these two variables may work together in influencing performance through a mediation model. That is, group potency (a general belief, with enduring temporal focus, and broad outcome emphasis) likely operates through collective efficacy (a proximal belief, with specific temporal focus, and sensitivity to specific situations):

> *Hypothesis 6:* The relationship between general group potency and group performance is mediated by the domain-specific collective efficacy.

Method

We initiated the identification of studies by computerized searches of the following databases: American Business Institute, Business Abstract, Business Source Elite, Academic Search, PsycINFO, Social Science Index, Dissertation Abstracts, and the University of Michigan Digital Dissertations. They include published work and unpublished dissertations. The keywords were as follows: *collective efficacy*, *group efficacy*, *team efficacy*, *group potency*, and *team potency*. We also manually searched (to ensure against electronic databases omissions) the following journals for the past 2 years: *Academy of Management Journal*, *Academy of Management Review*, *Administrative Science Quarterly*, *Group and Organization Management*, *Human Relations*, *Journal of Applied Psychology*, *Journal of Personality and Social Psychology, Organizational Behavior and Human Decision Processes*, *Personnel Psychology*, *Psychological Bulletin*, *Psychological Review*, *Small Group Research*, *Journal of Sport and Exercise Psychology*, and *International Journal of Sport Psychology*. We then searched for articles in reference sections of conceptual reviews and books on collective efficacy (Bandura, 1986, 1997, 2000, 2001; Mischel & Northcraft, 1997; Zaccaro et al., 1995), searched for articles in the *Academy of Management* and *Society for Industrial and Organizational Psychology* conference programs, and solicited unpublished work from a number of researchers.

Out of 290 studies initially identified, 127 appeared to be relevant (analyzed collective efficacy or group potency in relation to group performance, and used group level of analysis). Out of

Table 1
Collective Efficacy and Group Potency Definitions and Comparisons

Variable and source	Definition
Collective efficacy	
Bandura (1986)	". . . collective efficacy represents a sense of collective competence shared among individuals when allocating, coordinating, and integrating their resources in a successful concerted response to specific situational demands" (p. 309).
Bandura (1997)	"Collective efficacy is defined as a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (p. 447).
Group potency	
1. Shea & Guzzo (1987a)	"We define potency as the collective belief of a group that it can be effective, and employ it to interpret existing research on work groups in organizations" (p. 335).
2. Shea & Guzzo (1987b)	"Potency is the collective belief of group members that the group can be effective" (p. 26).
3. Guzzo et al. (1993)	"Potency is the collective belief in a group that it can be effective (Guzzo, 1986; Shea & Guzzo, 1987a)" (p. 87).
4. Guzzo & Dickson (1996)	"Guzzo et al. (1993) introduced the concept of group potency and defined it as the group's collective belief that it can be effective" (p. 313).
5. Campion et al. (1996)	"Teams should have a high sense of potency or belief that they can be effective (Guzzo, Yost, Campbell, & Shea, 1993)" (p. 432).
6. Sosik et al. (1997)	"Group potency defined as a group's collective belief that it can be effective (Guzzo, Yost, Campbell, & Shea, 1993) . . ." (p. 89).
7. Gully et al. (2002)	"Potency refers to generalized beliefs about the capabilities of the team across tasks and contexts (i.e., our team will be successful no matter what the task)" (p. 820).
8. Lester et al. (2002)	"Therefore, we define group potency as a group's shared belief that it can be effective" (p. 353).
9. Pearce et al. (2002)	"Team potency is the collective belief within a group that it can be effective (Guzzo, Yost, Campbell, & Shea, 1993)" (p. 115).
10. Hecht et al. (2002)	"Group potency has been defined as "the collective belief of group members that the group can be effective" (Shea & Guzzo, 1987[b], p. 26)" (p. 144).
Comparisons	
11. Shamir (1990)	"Perceived collective efficacy, as used here, is related but not identical to the concept of group potency (Guzzo, 1986) which refers to the collective belief in a group that it can be effective" (p. 317).
12. Guzzo et al. (1993)	"Potency, however, differs from collective efficacy in that potency is a *shared* belief in a group that it can be effective. Collective efficacy, in contrast, concerns individuals' beliefs not necessarily shared by others. Thus, potency is an attribute of groups whereas collective efficacy is an attribute of individuals" (p. 90).
13. Lindsley et al. (1994)	"We argue that collective efficacy and potency are distinguishable constructs . . . In other words, potency reflects a general assessment of the likely effectiveness of the team *across* situations, whereas team efficacy reflects shared performance expectations for a relatively *specific* situation" (p. 1).
14. Lindsley et al. (1994)	"Collective efficacy is task-specific; potency is meant to refer to a shared belief about general effectiveness across multiple tasks encountered by groups in complex environments (Guzzo et al., 1993, p. 9)" (p. 2).
15a. Zaccaro et al. (1995)	"Collective efficacy represents *a sense of collective competence shared among individuals when allocating, coordination, and integrating their resources in a successful concerted response to specific situational demands*" (p. 309).
15b. Zaccaro et al. (1995)	"Indeed organizational researchers have identified other psychological concepts that reflect perceptions of collective competence, share many properties of collective efficacy, but operate a much more general level (e.g., *collective control*, Zaccaro et al., 1990; *group potency*, Shea & Guzzo, 1987[a]). These constructs refer to members' perceptions that their group can successfully resolve *any* task or demand it may confront" (p. 314).
16. Gibson et al. (2000)	"Another unresolved issue is whether group performance beliefs are best represented as general beliefs concerning group effectiveness or as task specific beliefs" (p. 70).
17. Pearce et al. (2002)	"Potency and collective efficacy are highly related concepts-both are concerned with measurement of confidence at the group level of analysis (Shamir, 1990)" (p. 115).
18. Gully et al. (2002)	"Team-efficacy refers to perceptions of task-specific team capability, whereas potency refers to broader perceptions of team capability spanning task and situations (Gibson, 1996)" (p. 819).
19. C. Lee et al. (2002)	"Here we use the term group potency to mean beliefs about general ability and restrict group efficacy to mean beliefs about task specific ability" (p. 1629).
20. Jung & Sosik (2003)	"Guzzo et al. (1993) defined group potency as a 'shared belief' and thus argued that it is primarily a group-level construct, whereas Bandura (1997) believed that group efficacy is an individually based assessment of group capability" (p. 369).

127 studies, 31 studies were then excluded at the point of data entry for the following reasons: lack of needed statistics (e.g., sample size), not reporting the task description, and analyzing collective efficacy and/or group potency as a criterion rather than a predictor variable. Out of 96 remaining studies, 69 examined collective efficacy, 31 examined group potency, and 4 included both collective efficacy and group potency. Out of 96 studies, 43 reported multiple estimates from the same samples. Because estimates from the same samples are stochastically dependent (Cervone, 1987; Gleser & Olkin, 1994), which is incompatible with the chi-square distribution assumptions (used in homogeneity tests) and poses a host of other interpretation issues (Rosenthal, 1991), we adjusted them using Hedges and Olkin's (1985, p. 212) equations. After these adjustments, the final collective efficacy sample had 69 studies ($k = 83$ single correlations) and had a size of $N_{(groups)} = 4{,}250$, corresponding to $N_{(individuals)} = 18{,}891$. The average sample size per correlation was 51 groups, and the average group size was 4.4 individuals. The final group potency sample had 31 studies ($k = 35$ single correlations) and had a size of $N_{(groups)} = 1{,}878$, corresponding to $N_{(individuals)} = 12{,}128$. The average sample size per correlation was 54 groups, and the average group size was 6.5 members.

Primary and Moderator Meta-Analyses

These procedures relate to all three meta-analyses (collective efficacy–group performance, group potency–group performance, and collective efficacy–group potency). They follow Hedges and Olkin's (1985) method and analyses used in past meta-analyses (Stajkovic & Luthans, 1998).

We first determined single correlations for the relationship examined for each study by using Pearson's *r*, and then we calculated an unbiased estimate of *r* (because it underestimates rho), $G(r)$. To make the variance of $G(r)$ independent of rho, we converted $G(r)$ to the standard deviate *z*. We used *z* to calculate the weighted average correlations (Z_+). We also calculated 95% confidence limits for zeta and rho. The model cannot be specified unambiguously by the Z_+ if heterogeneity of *k* single correlations is present. To test for within-group homogeneity across all studies, we used the Q_t test. Given its high sensitivity to detect violations from homogeneity (Hunter & Schmidt, 1995, p. 112), we also used Hunter and Schmidt's (1995) 75% rule. We identified outliers by the *sample-adjusted meta-analytic deviancy* (SAMD) method (Huffcutt & Arthur, 1995).

Two of the authors coded the moderators, and the agreement for the first one (measurement) was 100%. For task interdependence, interrater reliability was $\rho = .90$, and the effective reliability was .95 on the basis of the Spearman–Brown formula. We did another round of coding by two new raters who were blind to the hypotheses. Their interrater reliability was $\rho = .89$, and the effective reliability was .94, suggesting the absence of bias in the first ratings.[1]

Whether weighted average correlations significantly differed from each other between/among the moderator groups was tested by the Q_b homogeneity test. If there were more than two average correlations, we further examined the pairwise differences by orthogonal polynomials.

Whether moderators explained variance within moderator groups was tested by the Q_w homogeneity statistic, which is an overall test of homogeneity of single correlations across all moderator groups. Q_{w1}–Q_{wp} were also calculated for each moderator group/class to see how much each homogeneity value contributed to the heterogeneity of the entire moderator group/class.

Collective Efficacy and Group Potency Comparative and Mediation Analyses

In these analyses, we (a) meta-analyze the group potency–group performance relationship, (b) compare it with that of the collective efficacy–group performance, and (c) examine a multivariate model in which collective efficacy mediates the relationship between group potency and group performance (which entailed conducting another meta-analysis between group potency and collective efficacy). The mediation model was tested by structural equation modeling based on the meta-analytic findings (Colquitt, LePine, & Noe, 2000; Judge, Jackson, Shaw, Scott, & Rich, 2007; Viswesvaran & Ones, 1995).

Structural Equation Modeling Analyses Based on the Meta-Analytic Findings

We obtained estimates of path coefficients, explained variance of endogenous variables, and chi-square values using LISREL 8 (Jöreskog & Sörbom, 1996). Meta-analytic correlation matrix for group potency, collective efficacy, and group performance was used as input in this analysis.

Meta-analytic confirmatory factor analysis. We first examined the discriminant validity between group potency and collective efficacy. It was assessed by a chi-square difference test between the full-three factor model (group potency, collective efficacy, and group performance) and a constrained model in which the parameter between group potency and collective efficacy was fixed to 1.00 (Anderson & Gerbing, 1988). The full model treats all three variables as separate constructs, and the constrained one treats group potency and collective efficacy as one construct. Paths from constructs to indicators were fixed to the values of the square root of the sample-size weighted mean reliability estimates. For studies that did not report reliability, we substituted missing values with the average reliability from those that did (Hunter & Schmidt, 1995).

Mediation model estimation. The proposed full mediation model was compared with three alternative models: (a) partial mediation, (b) correlated predictor, and (c) reversed-order mediation model. In the proposed mediation model, collective efficacy fully mediates the relationship between group potency and group performance. In the partial mediation model, group potency is related to performance directly and also indirectly through collective efficacy. In the correlated predictor model, group potency and collective efficacy are simultaneously related to performance as correlated predictors. In the reversed-order mediation model, group potency fully mediates the relationship between collective efficacy and group performance.

[1] We considered measures based on what was actually in the article, and not based on the labels used. For instance, there were a few "collective efficacy" studies in which the author(s) claimed to be measuring collective efficacy but were actually using Guzzo et al.'s (1993) group potency scale. In those few cases, we classified the studies as group potency studies rather than collective efficacy studies, despite the author's original label.

We also tested whether structural parameter values of the proposed mediation model differ across types and/or levels of moderators. We tested for invariance of structural parameters (a) across aggregation and discussion methods and (b) across medium and high levels of task interdependence (low task interdependence was not included because no group potency studies were identified with low task interdependence) by comparing two structural models: (a) a constrained model with restricting structural parameters to have the same value across subgroups and (b) an unconstrained model without such a restriction. As the first model is nested within the second model, a significant chi-square difference would indicate that parameters differ across subgroups.

Results

Collective Efficacy–Group Performance Relationship

Primary Meta-Analysis

Table 2 shows the results. The weighted average correlation between collective efficacy and group performance was $G(r_+) = .37$, $p < .01$, before removing SAMD outliers (Set 1), and $G(r_+) = .35$, $p < .01$, after removing SAMD outliers (Set 2), supporting Hypothesis 1. To avoid bias from deviant studies, we based further analysis on data (Set 2) without outliers. This reduced 6% of the correlations (from 83 to 78), representing below average reductions in social sciences (10%; Hunter & Schmidt, 1995) and notably lower reductions than in "exact" sciences (40%; Hedges, 1987).

Significant within-group heterogeneity of single correlations was present in each data set (per Q_t values in Table 2). The 75% rule values were consistent with the Q_t test. Significant within-group heterogeneity indicated that (a) magnitudes of single correlations were inconsistent among each other beyond chance, (b) the average correlation(s) could not be unambiguously interpreted, and (c) a moderator analysis was needed to account for the remaining systematic variance.

First-Level Moderator Analysis

Table 2 presents the results. The weighted average correlations for each collective efficacy assessment were significant—aggregation, $G(r_+) = .32$, $p < .01$; group discussion, $G(r_+) = .45$, $p < .01$—supporting Hypothesis 2. The between-groups homogeneity was significant ($Q_{bI} = 12.58$, $df = 1$, $p < .01$), indicating that the two average correlations were significantly different from each other. The test for homogeneity of single correlations (Q_{wi} values) showed significant heterogeneity for the first group (aggregation) and homogeneity (perhaps because of smaller sample size) for the second group (discussion). The 75% rule values were consistent. These results suggest that no significant systematic variance is left unaccounted in the second group (discussion) and that significant systematic variation is still present in the first moderator group (aggregation).

Second-Level Moderator Analysis

The aggregation group was further partitioned into three classes according to levels of task interdependence: high, medium, and low. Table 2 shows the results of this analysis. The average correlations for each class showed that collective efficacy significantly predicted group performance for high, medium, and low levels of task interdependence: $G(r_+) = .45$, $p < .01$; $G(r_+) = .25$, $p < .01$; $G(r_+) = .10$, $p < .05$, respectively. The between-classes homogeneity omnibus (given the three classes) test indicated that some of the average correlations were significantly different from each other ($Q_{bII} = 59.38$, $df = 2$, $p < .01$), and the orthogonal comparisons showed that they were all significantly different from each other. Thus, task interdependence level moderates the relationship between collective efficacy and group performance when the former is measured by the aggregation method, partly supporting Hypothesis 3. All three levels of task interdependence had homogeneity of within-class single correlations (indicating no remaining systematic variation), and the values of the 75% rule were in agreement.

Collective Efficacy and Group Potency Comparative and Mediation Analyses

The results of primary meta-analysis for group potency are presented in Table 2. The weighted average correlation between group potency and group performance was $G(r_+) = .31$, $p < .01$, before the SAMD outliers were removed, and $G(r_+) = .29$, $p < .01$, after the SAMD outliers were removed, both supporting Hypothesis 4. Although this difference in magnitudes of average correlations because of the removal of outliers was negligible, the difference in within-group homogeneities was important. Significant heterogeneity was present before the removal of outliers, and homogeneity occurred afterward. The 75% rule values were consistent with such conclusions. These results show that (a) magnitudes of single correlations were consistent among each other and that any remaining inconsistencies were due to chance, (b) average correlation can be unambiguously interpreted, and (c) moderator analysis was not needed.[2] Table 3 presents the comparisons between the average correlations for group potency–performance and collective efficacy–performance relationships.

Mediating Relationships

Group potency–collective efficacy relationship. The result of this third meta-analysis shows a high weighted average correlation between group potency and collective efficacy, $G(r_+) = .65$, $p < .01$.[3] To our knowledge, this is the first time such findings are reported.

Meta-analytic confirmatory factor analysis. The full three-factor model in which group potency, collective efficacy, and group performance are treated as separate constructs fits the data

[2] Of 32 group potency studies, 31 used aggregation, and only 2 studies used group discussion (1 study used both measures). Given that the magnitudes of the relationship were homogeneous across all potency studies with outliers removed (as reported), it was not (statistically) appropriate to conduct a moderator analysis on group potency studies. However, in analysis not reported here, but available from the authors, we found that the two different methods (i.e., group discussion and aggregation) of assessing group potency did not lead to statistically different average correlations between group potency and group performance.

[3] This average correlation is based on four studies ($k = 8$ single correlation estimates) and the sample size of $N_{(\text{groups})} = 284$, corresponding to $N_{(\text{individuals})} = 1{,}110$.

Table 2
Results of Meta-Analysis for the Collective Efficacy–Group Performance and Group Potency–Group Performance Relationship

Set[a]	s[b]	k[c]	$N_{(groups)}$	$N_{(individual)}$	Z_+	z[d]	$G(r_+)$	ρ_λ	ρ_υ	% SE[e]	Q_t	Q_{wI}[f]	Q_{bI}[g]	PS[h] index
Primary meta-analysis for collective efficacy														
All analyzed collective efficacy studies	68	83	4,250	18,891	.39	24.55**	.37	.34	.40	.33	302.08**			
Studies after outliers removed[a]	64	78	3,738	16,009	.36	21.16**	.35	.32	.38	.48	161.45**			.70[i]
First-level moderator meta-analysis												148.87**	12.58**	
Aggregated assessment	56	64	3,092	13,822	.33	17.78**	.32	.28	.36	.50	128.75**			.68[i]
Group discussion	12	14	646	2,187	.49	12.01**	.45	.37	.53	.77	20.12†			.76[j]
Second-level moderator												69.40†	59.38**	
High task interdependence	30	31	1,343	6,506	.48	16.99**	.45	.40	.51	.92	33.15†			.75[j]
Medium task interdependence	22	26	1,332	5,732	.25	8.92**	.25	.20	.31	.77	30.10†			.64[j]
Low task interdependence	5	7	417	1,584	.10	2.05*	.10	0	.20	1	6.12†			.56[j]
Grid vs. Likert-type collective efficacy scales												148.83**	4.87*	
Grid collective efficacy scale	25	32	1,560	6,235	.40	15.16**	.38	.33	.43	.45	71.07**			
Likert collective efficacy scale	38	41	2,014	9,018	.31	13.64**	.30	.26	.35	.54	77.06**			
Primary meta-analysis for group potency														
All analyzed group potency studies	32	35	1,878	12,128	.32	13.28**	.31	.26	.36	.35	124.50**			
Studies after outliers removed[a]	29	32	1,613	9,699	.30	11.69**	.29	.24	.34	.78	40.84†			.87[jk]

Note. Confidence limits are calculated at 95% certainty level. Significance values in the seventh column (z) are based on standard normal deviate z distribution where the null hypothesis is of no difference/effect. Significance values in the Q_t column are based on the chi-square distribution where the null hypothesis is model fits or is homogeneous. Thus, in the latter distribution, significant values indicate model heterogeneity. Values for ζ_l and ζ_u (95% lower [l] and upper [u] confidence limits for z parameter ζ), $\sigma^2_{G(r+)}$ (variance of the weighted average correlation), σ^2_e (sampling error variance), σ^2_ρ (variance of the population correlation), σ_ρ (standard deviation of the population correlation), $G(r_+)/\sigma_\rho$ (distance from 0 value of population correlation expressed in standard deviations) are available for all analyses from the authors.

[a] Results based on data with outliers removed according to the sample-adjusted meta-analytic deviancy method as described in the manuscript. [b] Number of individual studies. [c] Number of individual correlations. [d] Value of the z test statistic. [e] % SE = percentage of variance attributable to sampling error. [f] Within-group overall homogeneity for the level of moderation. [g] Between-groups homogeneity for the level of moderation. [h] For calculations, see Grissom (1994), and for its origins in mathematics, see McGraw and Wong (1992) as well as Wolfe and Hogg (1971). [i] Interpretational caveat is offered because there is statistically significant within-group heterogeneity of single correlations. [j] There is no need for an interpretational caveat because there is not statistically significant heterogeneity. [k] The probability of success (PS) index when collective efficacy is measured as a mediator between group potency and group performance is .78.

† $p > .05$. * $p < .05$. ** $p < .01$.

Table 3
Statistical Comparisons Between Collective Efficacy–Group Performance and Group Potency–Group Performance Meta-Analytic Average Correlations

Contrast description[a]	Average correlations	γ[b]	v_1^c	v_2^d	v_γ^e	CL_l	CL_u	Interpretation[f]
CE (overall) vs. GP	.36 vs. .29	.06	.001	.001	.001	.001	.120	1a
CE (aggregation measure) vs. GP	.33 vs. .29	.03	.001	.001	.001	−.032	.092	1b
CE (group discussion measure) vs. GP	.49 vs. .29	.19*	.001	.001	.002	.096	.284	2
CE (aggregation measure, high task interdependence) vs. GP	.48 vs. .29	.18*	.001	.001	.001	.105	.254	2
CE (aggregation measure, medium task interdependence) vs. GP	.25 vs. .29	.05	.001	.001	.001	−.025	.125	2
CE (aggregation measure, low task interdependence) vs. GP	.10 vs. .29	.20*	.003	.001	.003	.089	.311	2

Note. Confidence limits (CLs) are calculated at 95% certainty level (l = lower, u = upper). All values are after outlier analyses. Group potency–group performance relationship is represented in every comparison by the same .29 estimate because the relationship was homogeneous, and there was no moderator analysis.
[a] CE = collective efficacy; GP = group potency; Aggregation measure = shorter label that we use in this table for the first method of CE assessment described in the article (individual assessments of CE of a group that are then aggregated). Group discussion measure = shorter label we use in this table for the second method of CE assessment described in the article (group discussion resulting in one estimate of group's collective efficacy). [b] γ = value of the comparison estimate. [c] v_1 = variance of the first comparison component. [d] v_2 = variance of the second comparison component. [e] v_γ = variance of the comparison estimate. [f] 1a = ambiguous for CE (overall); performance relationship was heterogeneous; 1b = ambiguous for CE (aggregation measure); performance relationship was heterogeneous; 2 = unambiguous; all relationships were homogeneous.
* $p < .05$.

significantly better than the constrained two-factor model in which group potency and collective efficacy are treated as one construct, $\Delta\chi^2(2) = 695.00$, $p < .01$. These results provide initial evidence of discriminant validity between group potency and collective efficacy. Also, none of the confidence intervals around the correlations between each pair of factors included the value of 1.00, which provides further support for discriminant validity (Anderson & Gerbing, 1988).

Mediation model. Correlation matrices among the three variables used in these analyses (and subsequent invariance test on moderators) are presented in Table 4, and the results of model comparison tests are presented in Table 5. First, a nested model comparison between the proposed full mediation model and saturated partial mediation model led to a negligible chi-square difference, $\Delta\chi^2(1) = 0.65$, $p > .05$, indicating that the proposed model is more parsimonious and fits the data equally well with one link less. The direct effect of group potency on group performance was not significant ($\gamma_{21} = .06$, $p > .05$), whereas over 80% of the total effect of potency on performance was due to its indirect effect (.27, $p < .01$) in the partial mediation model. These results show that the direct link from group potency to group performance is superfluous in explaining these data.

Second, the comparison with the correlated predictor model also favored the proposed mediation model, $\Delta\chi^2(1) = 0.65$, $p > .05$. Moreover, in the correlated predictor model, the coefficient of group potency was not significant ($\gamma_{11} = .06$, $p > .05$), whereas that of collective efficacy was ($\gamma_{12} = .36$, $p < .01$). Finally, the reversed-order mediation model tests a different causal order in which collective efficacy precedes group potency. This reversed-order mediation model is not in a nested relationship to the proposed model or the saturated, partial mediation model. However, given the same degrees of freedom for both the proposed and the reversed-order mediation model, the former provides better fit to the data than the latter; fitting the reversed-order mediation model to the data resulted in a poor fit, $\chi^2(1) = 21.92$, $p < .01$. These results seem to strongly support an indirect relationship

Table 4
Meta-Analytic Estimates of Intercorrelations Among the Study Variables

	Overall			Measurement method subgroup						Task interdependence subgroup					
				Discussion			Aggregation			Medium			High		
Variable	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1. CE															
2. Potency	.65			.56			.68			.52			.71		
	8/284			3/88			5/196			4/116			4/168		
3. Group performance	.35	.29		.45	.41		.32	.28		.27	.26		.45	.41	
	78/3,738	32/1,613		14/646	2/129		64/3,092	30/1,484		31/1,555	25/1,155		40/799	7/358	

Note. Tables entries are estimated average correlations. Below each correlation appears the number of individual correlations (k) first followed by the total sample (group) size. Given that each element of the correlation matrix was based on different sample sizes, the conservative harmonic mean was used for the model fit tests (Viswesvaran & Ones, 1995). CE = collective efficacy.

Table 5
Results of the Meta-Analytic Structural Equation Model Comparisons

Path coefficient	Proposed mediation model	Partial mediation model	Correlated predictor model	Alternative-order mediation model
PO → CE	.76**	.76**		
CE → PO				.77**
CE → PFM	.41**	.36**	.36**	
PO → PFM		.06	.06	.36**
χ^2	.65	.00	.00	22.23**
df	1	0	0	1
$\Delta\chi^{2a}$		.65	.65	21.92**
Δdf		1	1	0
Total effect of PO on PFM	.31**	.33**	.06	.36**
Indirect effect of PO on PFM	.31**	.27**		
Total effect of CE on PFM	.41**	.36**	.36**	.28**
Indirect effect of CE on PFM				.28**

Note. n = 681 groups (on the basis of harmonic mean). PO = group potency; CE = collective efficacy; PFM = performance.
[a] Chi-square difference for each model reflects its deviation from the proposed model.
** $p < .01$.

between group potency and group performance with collective efficacy as a full mediator (see Figure 1 for parameter estimates).

Structural parameter invariance test on moderators. This test on measurement moderator showed that the effects of group potency on collective efficacy and of collective efficacy on group performance are equal across aggregation and discussion methods. The chi-square difference between constrained, $\chi^2(2) = 4.01$, $p > .05$, and unconstrained models, $\chi^2(4) = 7.98$, $p > .05$, was not significant, $\Delta\chi^2(2) = 3.97$, $p > .05$. The coefficients γ_{11} and β_{21} were .77 and .42, respectively (almost the same as in Figure 1). This test on the task interdependence moderator showed a significant chi-square difference, $\Delta\chi^2(2) = 14.59$, $p < .05$, suggesting that the parameters are not equal across medium and high levels of task interdependence. Although the full mediation holds for both conditions (nonsignificant chi-square of the unconstrained model), $\chi^2(2) = 4.78$, $p > .05$, the effects of group potency on collective efficacy and of collective efficacy on group performance were stronger for high than medium task interdependence; coefficients γ_{11} and β_{21} were .62 and .32 for medium task interdependence, and .83 and .53 for high task interdependence, respectively.

Discussion

There are several contributions of this research. First, the finding that collective efficacy is positively related to group performance was based on findings from 69 studies, 83 adjusted correlation estimates, 4,250 groups, and 18,891 individuals, and it has held up after outlier analysis and other conservative adjustments. This meta-analytic finding is important, in a general sense, because it is typically more reliable than an estimate derived from a single study.

Second, first-level moderator that used the two assessments of collective efficacy showed significantly different average correlations with group performance. The face implication appears straightforward: If group discussion is used, better results may be expected than those produced by an aggregation. However, this

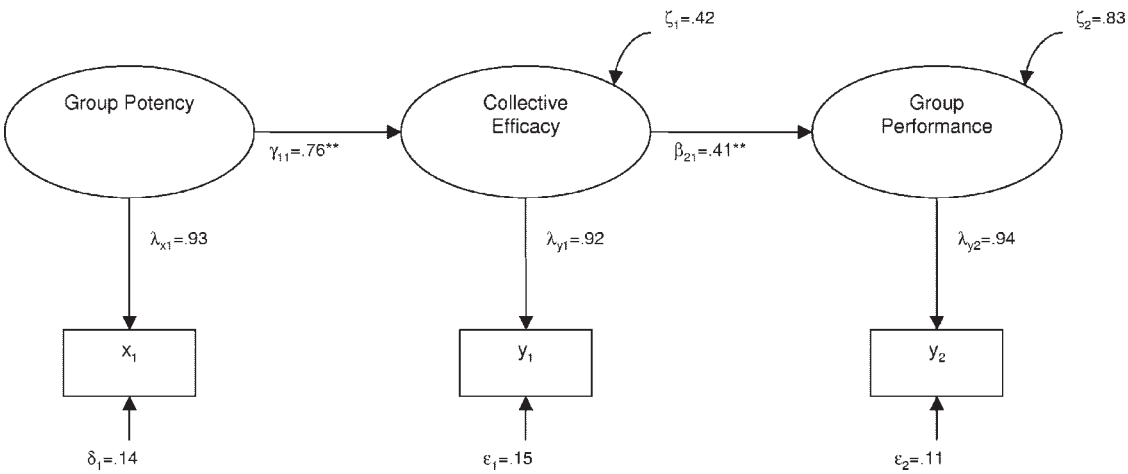

Figure 1. Proposed mediation model (n = 681, on the basis of harmonic mean). ** $p < .01$.

comparison cannot be unambiguously made given the significant heterogeneity for the aggregation (group discussion was homogeneous). The more appropriate comparison is between the two homogeneous average correlations, for example, the average correlation for group discussion is the same as for aggregation and high task interdependence (.45 vs. .45) but higher than that for aggregation and medium task interdependence (.45 vs. 25).

Third, aside that one may work better than the other, another potential explanation for the difference in average correlations between the group discussion and the aggregation may be the type of collective efficacy scale. In his guide on efficacy scales, Bandura (2006) has recommended against the use of Likert scales for (either self or collective) efficacy measurement. In short, the argument is that Likert scale anchors to the left of the middle one (which, it can be reasonably argued, stands for "I do not know," and/or "I do not care," and/or "I am indifferent") are incongruent with the "can do" (up to 100% certainty) efficacy belief. We also tested whether this reasoning holds with our data. We found that the average correlation between collective efficacy and group performance produced by Likert scales, $G(r_+) = .30$, compared with that from grid scales, $G(r_+) = .38$, was significantly lower ($Q_{bI} = 4.87$, $p < .05$; see Table 2), which is in line with past self-efficacy research (C. Lee & Bobko, 1994). Pertinent to explaining potential differences in average correlations between the aggregation and the group discussion may be that only 21/64 (33%) of the aggregation studies used grid scales compared with 11/14 (79%) of group discussion studies.

Fourth, we found that (a) group potency is positively related to performance, (b) group potency is a different construct from collective efficacy, and (c) the former relationship is weaker (see Table 4) than for collective efficacy for either assessment and high task interdependence. These comparative results, however, should be viewed in light of the results from our mediation model in which group potency had no direct (and only indirect) impact on performance in the presence of collective efficacy. Although this is the first time that such mediation results have been reported for group potency and collective efficacy, they are consistent with past research: Motivation traits often impact performance through the context specific variables (Locke, 2001; Baum & Locke, 2004).

Practical Implications

Research (Rauschenberger & Schmidt, 1987; Schmidt & Hunter, 1998) suggests that statistical estimates shown in practical terms help managers better understand the findings. An applied index, the probability of success (PS), related to average correlations has been developed by Grissom (1994). It shows the practical meaning of meta-analytic findings—the extent to which a randomly selected group/person from one condition is likely to obtain a higher score on the criterion than a randomly selected group/person from another condition. We present PS index values in Table 2 (last column), as they relate to the relationships that we examined.

Differences Between the Previous Review and the Present Work

We examined more studies/correlations than was examined in the past meta-analysis by Gully et al. (2002), including more published versus unpublished studies.[4] We also evaluated a broader scope of studies; for example, we included experiments, but the former study did not. Because of the high internal validity of experiments regarding causality of effects (Cook & Campbell, 1979), Kluger and DeNisi (1996) have urged meta-analysts to include experiments (and we agree): "The lack of a control groups in the present literature may bias our results to an unknown degree" (p. 277).

Our results also differ from those of the past review in that (a) collective efficacy–group performance average correlation was .41 then and .35 now (15% difference); (b) we found a 41% difference (.32 aggregation vs. .45 group discussion) in the moderator analysis—Gully et al. (2002) used these assessments as control variable and reported that it made no difference in their conclusions; (c) the correlation between collective efficacy and performance for low task interdependence was .34 then and .10 now (240% difference); and (d) we tested the mediation model for the first time.

Homogeneity analysis is critical for unambiguous interpretation of results. As Hunter and Schmidt (1995) have noted (see also Cooper, 1997; Hedges & Olkin, 1985) regarding the implications of homogeneity in meta-analysis, "if the chi square is not significant [is homogeneous], this is strong evidence that there is no true variation across studies" (p. 112). Every final nested analysis (average correlation) we report shows within-group homogeneity and can be interpreted unambiguously. In contrast, earlier study results were more equivocal because a number of them had het-

[4] vThe total number of studies that we examined increased 60% (96 vs. 60), including an increase in a number of group-level correlations of 66% (118 vs. 71). A larger part of the increase in correlations (98%) was found in the collective efficacy research (83 vs. 42). We obtained these comparisons in this manner. Gully et al. (2002, pp. 824–825, including Table 1) reported the total number of studies and correlations for collective efficacy–group performance and group potency–group performance relationships *combined*. They did not report how many studies that they examined for the former relationship and how many for the latter, or how many correlations relate to each relationship at the beginning of the analysis (see Table 1 in Gully et al.'s, 2002, study). Thus, on the basis of the references in Gully et al.'s study, we counted the studies with an asterisk (marking those used in meta-analysis) to arrive at the total number of studies that they examined. However, by this method only, we could not exactly determine which study used which estimates, and thus it was not possible to determine exactly how many studies were used for collective efficacy–group performance and group potency–group performance relationships. Thus, we used the number of correlations (42) reported for "team efficacy at the team level." We took the number of correlations from this analysis because the first four analyses preceding this one (reported in Table 1 by Gully et al., 2002) combined collective efficacy–group performance estimates and group potency–group performance estimates in one analysis; because we were not sure how to interpret resulting average correlations from these combined analyses, we used the number of correlations (42) from the next analysis (team efficacy at the team level) to compare with our number of correlations. We also examined 82% more studies (31 vs. 17) of the relationship between group potency and group performance than the previous study. In addition, the ratio of published versus unpublished studies has also increased to 67% in our data set, as compared with 51% in the 20-year period (1982–2002) covered by Gully et al.'s data (i.e., nearly half of the studies they used—49%—were unpublished, possibly indicating "growing pains" of the field then).

erogeneity of single correlations (unaccounted systematic variance) present. The two key issues with such findings are (a) they cannot be interpreted unambiguously, and (b) they give fuel to the most visible criticism of meta-analysis—that it frequently compares apples and oranges (see Hunt, 1997). The latter, unfortunately, cannot be statistically refuted if there is significant heterogeneity of single correlations within an average correlation.

Where Do We Go From Here? Limitations and Future Research

Bandura (1997) has warned that power pressures exerted during group discussion can change the phenomenon being assessed. We agree and reiterate that we do not know the extent to which social influences during the group discussion affected the reported levels of collective efficacy in the primary studies. Unimpeded discussion about a group's capabilities may have contributed to a strong average correlation with group performance. This is not to say that power pressures, if present, would not change the accuracy of the collective efficacy estimate and adversely impact the correlation with performance. Future research is needed to experimentally compare the treatment conditions in which group discussion is unmitigated and frothed by power pressures.

Thus, as discussed earlier, one limitation is that we were unable to examine the variability in the discussion assessment. Future research may focus on developing an index of shared belief within a group for the group discussion. The collective efficacy definition refers to a "group's shared belief" in their capabilities, but to what extent such belief is shared (and what the impact of it is) when *one* assessment per group is produced has not been examined. An index, showing an extent to which beliefs within a group are shared, would allow us to reveal variance among group members in their collective efficacy beliefs comprising one-per-group estimate. This could be consequential because some groups may share beliefs to different extents (as shown by this index). We suggest that the less a group shares efficacy beliefs, the more adverse the consequences.

Another limitation is that measures of group potency and collective efficacy are "murky" (as Table 1 shows). Future research is needed to further sort out the psychometric properties of each construct. Further, we do not discuss, which is also a limitation, potential differences among outcomes in terms of finer grained measure analysis (e.g., self-reported vs. objective, overall performance vs. specific performance). Potentially, either collective efficacy and/or group potency may be more related to one performance outcome and/or measurement than another.

Future research may also examine the pattern of collective efficacy (and group potency) in addition to its level; the latter may vary for different patterns of a social system (e.g., members of various cultures may have different responses to group influences/social norms). For instance, in comparing collective efficacy of groups nested in different cultures, one may separate (e.g., by hierarchical linear modeling) within-group variance in collective efficacy due to group dynamics (i.e., level) and between-groups variance generated by cross-cultural differences (i.e., pattern).

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References marked with an asterisk indicate studies included in the meta-analysis. References marked with two asterisks indicate new collective efficacy–group performance studies identified since Gully et al.'s (2002) review that are in the analysis. References marked with three asterisks indicate new group potency–group performance studies identified since Gully et al.'s review that are in the analysis.

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