Relation of Collective Efficacy Beliefs to Group Cohesion and Performance in Student Project Teams

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Abstract

This study extends Bandura's[1] concept of collective efficacy to the context of student project teams in engineering education. Collective efficacy refers to team members' beliefs about the ability of their team to perform its tasks effectively. Members of student project teams in an introductory engineering design course completed measures of their teams' collective efficacy, cohesion, and performance. Course instructors also independently rated each team's performance. Findings indicated that collective efficacy was strongly related to students' ratings of their teams' cohesion and performance, both at the individual and group levels of analysis. Collective efficacy was also moderately related to instructors' ratings of team performance. We consider the implications of these findings for further research and practice involving team functioning.

Introduction

Social cognitive theory[1] is an influential approach to understanding the psychosocial processes involved in human motivation, choice, and performance. A large body of research has accumulated examining social cognitive variables, especially self-efficacy, in relation to various aspects of academic and career-relevant behavior. Social cognitive career theory (SCCT)[2] was developed a decade ago to help organize and lend direction to this inquiry. SCCT was designed to explain the processes through which people develop educational and career interests, translate their interests into occupationally-relevant choices, and achieve varying levels of performance and persistence in academic and work domains. Research findings have consistently supported the theory's utility in predicting the academic choice and performance behavior of students in science, math, and engineering fields[3].

While social cognitive theory has provided a heuristic perspective on career and educational behavior, the research literature has focused primarily on the linkages of social cognitive variables to outcomes achieved by students and workers as individuals. This focus makes a great deal of sense given that educators and psychologists are largely concerned with maximizing the development of individuals. It is obvious, however, that people do not only study and work alone. In the contemporary world, efforts at social change, economic productivity, and technological progress typically require that people harness their energy together to achieve common ends. Indeed, the need to blend individuals together effectively within groups, teams,

and organizations is widely recognized, and cooperative learning and teamwork are garnering increasing attention among educational and organizational scholars.

Although research on social cognitive theory has emphasized individual-level processes and outcomes, Bandura's theory[1] is also concerned with group functioning. "Collective efficacy," a group-level construct within social cognitive theory, is designed to help explain how social units function more or less well together. Bandura has defined collective efficacy as a "group's shared beliefs in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (p. 477). In contrast to self-efficacy, which involves a person's beliefs about his or her ability to perform particular behaviors individually, collective efficacy refers to group members' aggregate beliefs about how they can perform *as a unit*.

Collective efficacy is "an emergent group-level attribute." (p. 478) that is assumed to influence group processes (e.g., goal setting, management of resources, coordinative activities, task strategies employed, effort expenditure, perseverance despite set-backs, morale) and outcomes (e.g., level of performance achieved as a group)[1]. The strength of the relationship between collective efficacy and group performance may depend on several moderator conditions, such as the extent to which particular tasks require members to function interdependently. Collective efficacy may have a more pronounced effect on group performance where group members need to interact closely and coordinate their behaviors; it may be less important where tasks can be accomplished by members working independently from one another[1,4].

Collective efficacy beliefs are assumed to derive from a variety of informational sources, some of which represent group analogues to the sources of self-efficacy (e.g., prior group successes and failures, vicarious exposure to similar other groups) and some of which are unique to the group context (e.g., quality of leadership behaviors, cohesion among group members)[5]. Collective efficacy differs, conceptually, from alternative constructs, such as group potency, that have been offered to account for group functioning. For example, collective efficacy beliefs are task-specific (e.g., groups may have different levels of collective efficacy depending on what they are required to accomplish) rather than being global (group potency) in nature.

The collective efficacy construct may be applied to "any aggregation larger than the individual, from dyads to nations" [5]. Although the literature on collective efficacy has grown much more slowly than that of self-efficacy, its research base has expanded considerably in recent years and it has proven to be a very flexible group-level explanatory construct, finding application to groups of diverse size, function, and organizational context. In a recent meta-analysis, Stajkovic & Lee reported an average correlation between collective efficacy and performance of .45[4]. Thus, across the set of studies reviewed, collective efficacy accounts for roughly 20% of the variance in group performance, which represents a moderately strong effect size. Consistent with expectations, task interdependence was found to moderate collective efficacy-group performance relations, with stronger relations under conditions where tasks require high versus low member coordination.

In the present study, we sought to examine the correlates and consequences of collective efficacy within the context of student project teams in engineering. There has been growing emphasis on student acquisition of team skills and experience in engineering education within recent years[6].

Mirroring the popularity of work teams in the engineering workplace, student project teams are designed to enhance the learning process by enabling students to develop skills at managing team interactions. However, team interpersonal dynamics often pose unique challenges for students and professors, such as how to handle inter-member conflicts and ensure that all students are contributing to, and profiting from, the team experience[7,8]. Much is yet to be learned about what factors enhance team functioning and how such factors can be intentionally fostered by professors and team members. It therefore seems important to study group-level variables, such as collective efficacy, that may both shed light on project team functioning and suggest ways to assist teams to work together more effectively.

We have developed a programmatic set of studies extending collective efficacy to the understanding of student project teams. In the first study in this series, we developed a measure of collective efficacy beliefs linked to student team functioning and administered it to 188 students enrolled either in a freshman engineering design course or a senior-level electrical engineering course[9]. We found that collective efficacy beliefs were strongly related to indices of team cohesion and satisfaction with team functioning. They were also related to students' sense of self-efficacy, interests, and social support relative to remaining in engineering. Seniors reported significantly stronger collective efficacy than did freshmen, suggesting that, with increasing team experience, students gain confidence in their ability to manage project team interactions.

Our first study, aimed mainly at measure development and validation, examined collective efficacy beliefs at the *individual* level of analysis (i.e., individuals' perceptions of their team's functioning). The current study was aimed at replicating and extending our earlier findings by examining collective efficacy at both the individual and group levels of analysis (i.e., aggregating individual members' perceptions into a shared, collective estimate of team functioning). Because collective efficacy is a group level variable, it is crucial to test how aggregate (i.e., shared) efficacy beliefs relate to measures of group (vs. individual) functioning. In this study, we specifically explored the relation of collective efficacy estimates to students' self-efficacy beliefs, appraisals of the team environment (cohesion), and performance. In addition, we examined the relation of team collective efficacy to external (e.g., instructor) ratings of team performance. Based on relevant prior findings, we hypothesized that collective efficacy beliefs would be (a) strongly predicated by the combination of cohesion and self-efficacy, and (b) moderately to strongly predictive of team performance as assessed both by team members and course instructors.

Method

Participants: Participants were 281 students (74% men, 22% women, 4% sex-unidentified) enrolled in an introductory engineering design course at a large Eastern university. They were divided into 50 project teams. The students were primarily first (78%) and second-year (17%) students. In terms of race/ethnicity, 6% self-identified as Black or African American, 4% as Hispanic, 17% as Asian or Asian American, 66% as White or European American, and 6% reported other (e.g., multiracial) racial/ethnic identifications. Mean self-reported mathematics SAT scores were 708.80 (SD = 59.70). The large majority of participants were planning to

continue on in engineering, with most expressing preferences for mechanical (27%), electrical (16%), aerospace (15%), or computer (13%) specialties.

Procedure and Instruments: All participants completed the measures in class during the last two weeks of the same semester (Fall, 2002). As part of the engineering design course, students were divided into project teams by course instructors. Teams were assigned a common project: to develop a working water pump by the end of the semester. They were expected to pool their talents and coordinate all tasks needed to produce the final product. In most cases, teams met weekly to coordinate their activities. They were allowed to select their own leaders and to distribute specific roles (e.g., technical report writer) as they saw fit. Instructors served as team consultants and provided the team with basic and technical background material related to the design and construction of the project. Data were gathered at the end of the semester so that (a) students' team ratings would be based on maximal exposure to their project teams and (b) self-efficacy responses would be based on at least one semester of college-level experience. Students completed measures of self-efficacy, collective efficacy, team cohesion, and team performance. They also provided demographic and academic status information. Survey responses were obtained from 3-10 members per team (average = 5.62 respondents per team). For the purpose of group-level analyses, team members' ratings were averaged together to produce group indices of self-efficacy, collective efficacy, cohesion, and performance. Course instructors also provided independent ratings of each teams' functioning and performance at the end of the semester. Ratings were obtained from 9 course instructors, with an average of 5.55 project teams per instructor.

Self-efficacy: Self-efficacy was assessed with an 11-item measure consisting of four items tapping perceived individual ability to attain particular academic milestones and seven items reflecting individual ability to negotiate barriers to academic progress[10]. Participants indicated their confidence in their ability to perform each task (e.g., "excel in your engineering major over the next semester;" "cope with a lack of support from professors or your advisor") on a on a 10-point scale, ranging from *no confidence* (0) to *complete confidence* (9). Self-efficacy scores were calculated by dividing the summed item responses by 11, producing a possible score range of 0-9, with higher scores reflecting stronger efficacy percepts. The coefficient alpha value of the self-efficacy scale in the present study was .93 (scale internal reliabilities were estimated on individual-level responses).

Collective efficacy: Collective efficacy was assessed with a 9-item measure developed by Lent et al. (2002). Participants were asked to indicate how confident they were that their team could perform a variety of activities successfully as a unit (e.g., "reach agreement about what needs to get done at each meeting;" "develop a workable project design in a reasonable amount of time"). Responses were obtained along a 10-point scale, ranging from *no confidence* (0) to *complete confidence* (9). Item responses were summed and divided by 9, yielding a 0-9 score range, with higher scores indicating stronger perceptions of collective efficacy. The coefficient alpha estimate of the collective efficacy measure in the present study was .94.

Team cohesion: Participants rated the cohesion of their project teams using a 6-item measure that was adapted by Lent et al. (2002). Participants responded by indicating the degree to which they agreed with each item (e.g., "there is a feeling of unity and cohesion in this team"), using a 5-

point scale (*strongly disagree* = 1; *strongly agree* = 5). Item responses were summed and divided by 6, yielding a 1-5 score range; higher scores reflect stronger team cohesion. The measure produced a coefficient alpha of .92 in the current study.

Student-rated team performance: Students were asked to rate their team's performance using a 10-item measure (e.g., "discussions are focused and useful;" "team meetings are always productive"). Item responses were obtained along a 5-point scale (*strongly disagree* = 1; *strongly agree* = 5), summed, and divided by 10, producing a 1-5 score range. Higher scores reflect more positive assessments of the team's process in fulfilling its assignment. The performance measure produced a coefficient alpha estimate of .90 in this sample.

Instructor-rated team performance: At the end of the semester, after team projects were completed, instructors were asked to rate each team in their course sections along three dimensions: amount of effort put into the project, quality of the product, and how effectively the team functioned overall. Each dimension was rated on a 3-point scale, with higher ratings reflecting better team performance. The item ratings were summed and divided by 3, producing a 1-3 score range.

Results

Table 1 contains means, standard deviations, and intercorrelations among the variables at both the individual and group levels of analysis. (Instructor ratings of team performance only appear as a group-level variable because teams, rather than individuals, were the rating target on this variable.) Before testing our hypotheses, we examined the intraclass correlation coefficients (ICC) of each student-rated variable. The ICC reflects scale reliability at the group level, or the extent to which teams can be reliably differentiated from one another using mean levels of each variable. ICC values for self-efficacy, collective efficacy, cohesion, and performance were, respectively, were .01, .48, .47, and .78. These values suggest that teams could be reliably differentiated based on mean levels of all variables except for self-efficacy. Self-efficacy may best be considered an individual level variable since the teams did not vary appreciably as a function of their members' self-efficacy scores. We did, however, analyze self-efficacy at individual and group levels based on theoretical considerations.

Our first hypothesis held that collective efficacy beliefs would be strongly predicted by the combination of cohesion and self-efficacy. As shown in Table 1, collective efficacy was moderately related to self-efficacy and strongly related to team cohesion at both the individual and group levels of analysis. In a multiple regression predicting collective efficacy at the group level, both cohesion ($\beta = .66$) and self-efficacy ($\beta = .44$) explained significant unique predictive variance, jointly accounting for 66% of the variance in collective efficacy. These findings support our hypothesis about the antecedents of collective efficacy.

Table 1 Scale Correlations, Means, and Standard Deviations

Scales	1	2	3	4	5	*M*	*SD*
1. Collective Efficacy	--	.47*	.69*	.67*	.35*	7.59	.66
2. Self-Efficacy	.46*	--	.06	.19	.04	6.55	.70
3. Cohesion	.60*	.17*	--	.62*	.51*	3.96	.51
4. Team Perform1	.57*	.15*	.50*	--	.36*	4.34	.39
5. Team Perform2	--	--	--	--	--	2.61	.42
M	7.57	6.54	3.97	4.33	--		
SD	1.19	1.50	.78	.63	--		

Note. Individual-level correlations appear below the diagonal; group-level correlations are above the diagonal. Team Perform1 = Ratings of team performance by students; Team Perform2 = Ratings of team performance by course instructors.
N = 281 students, 50 project teams. *$p < .05$, one-tailed.

Our second hypothesis was that collective efficacy would be at least moderately predictive of team performance as assessed both by team members and course instructors. Examination of Table 1 confirms that collective efficacy strongly predicted the team's assessment of its performance at both the individual ($r = .57$) and group ($r = .67$) levels. Collective efficacy was also moderately related to instructor ratings of team performance ($r = .35$). Thus, the findings support the hypothesized consequences of collective efficacy. Interestingly, student and instructor ratings of team performance were moderately related ($r = .36$); cohesion was strongly related to both student and instructor ratings of team performance; but correlations of self-efficacy to team performance criteria were consistently small (and non-significant at the group level).

As a supplementary analysis, we examined the possibility that collective efficacy might mediate the relation between cohesion and team performance. Specifically, we used partial correlations to predict student and instructor-rated team performance from cohesion, controlling for the effects of collective efficacy. Results suggested that, in each case, partialling out collective efficacy only slightly reduced the relation between cohesion and team performance: for student-rated performance, at the group level, the relation dropped from .62 (bivariate correlation) to .30 (partial correlation); for instructor-rated performance, the corresponding values were .51 and .40. Thus, collective efficacy may only partly mediate, or explain, the relationship between cohesion and team performance.

Discussion

The present findings provide support for the hypothesized antecedents and consequences of collective efficacy. Bandura had proposed that collective efficacy is "rooted in self-efficacy" (p. 480)[1]. For instance, individuals may judge their group's conjoint efficacy, in part, by considering their personal capabilities and that of the other group members. Although we had assessed self-efficacy and collective efficacy in relation to somewhat differing performance domains (i.e., academic skills in engineering vs. team interaction skills, respectively), we found that they were, nevertheless, moderately related. Our results are consistent with Bandura's contention and with recent findings[11] suggesting that members' self-efficacy informs their

collective efficacy appraisals. It is also possible that the team experience reciprocally promotes self-efficacy by exposing students to competent peer models and engaging them in new technical and interpersonal tasks that can expand their skill (and self-efficacy) range.

At the same time, the modest size of the correlation between self and collective efficacy suggests that the two measures reflect distinct, though related, constructs. In other words, collective efficacy regarding team functioning is not merely an extension of member's beliefs about their personal abilities to negotiate engineering coursework. The small intraclass correlation coefficient for self-efficacy also suggests that most of the variance in this construct is attributable to individuals' private appraisals rather than to their shared experiences as group members. Additionally, self-efficacy was minimally associated with team performance indices, though it typically serves as a good predictor of individual performance[2]. On balance, these findings support the view that team competencies represent a distinctive skill set within the academic curriculum, a set that may require unique (i.e., team-based learning) experiences to cultivate.

Collective efficacy was also strongly and independently predicted by team cohesion. These results are consistent with previous findings demonstrating relations between cohesion and collective efficacy[12]. Thus, in gauging their collective efficacy, students may have relied partly on their sense of how well they got along with or liked other team members. Although group harmony does not ensure effective team functioning, fractious groups are likely to have more difficulty coordinating work on tasks that require joint effort and may be more likely to get side-tracked by "off-task" issues, such as inter-member conflicts. In such cases, collective efficacy (and team performance) is likely to suffer.

We had conceptualized cohesion as one source of collective efficacy in teams – particularly in situations, as in our study, where team members have had no or minimal prior experience together and, therefore, cannot draw on possibly more compelling factors (e.g., prior group successes) as a basis for assessing their collective efficacy. Of course, as discussed in relation to self and collective efficacy, it is also possible that the relationship between cohesion and collective efficacy is bi-directional[5]. That is, over time, cohesion promotes collective efficacy, while a sense that the team is an effective unit, in turn, breeds pride in group membership and affective bonds (i.e., cohesion) among team members. In this analysis, cohesion early in a team's life may jumpstart collective efficacy, but demonstrated success at group tasks would be necessary to sustain collective efficacy and cement cohesion over the long run.

Consistent with theory[1] and prior research[4], our findings also indicated that collective efficacy was predictive of team performance, as judged by teams as well as instructors. Of course, the strong relation of collective efficacy to team-rated effectiveness may have been inflated by mono-source bias (i.e., team members provided both sets of ratings). While the team's view of its own performance does offer a useful vantage point from which to assess team functioning – and team and instructor-rated performance measures were moderately interrelated – greater weight should probably be placed on instructor ratings in assessing the magnitude of the collective efficacy-team performance relationship. As "insiders," students have an in-depth, privileged perspective on their team's process. Yet by virtue of their subject matter knowledge, experience, and role, instructors have the final say in grading team performance, including determining the quality of team products.

Collective efficacy-performance relations are assumed to be moderated by task interdependence (i.e., the extent to which tasks require inter-member coordination)[1], and meta-analytic findings support this hypothesis[4]. We, unfortunately, could not test this hypothesis in our study because all teams were assigned the same task and the degree of interdependence among members within teams was not assessed. However, anecdotal reports from instructors and participants suggest that, although the team task (creation of a working water pump) was designed to require high interdependence, individual teams varied in terms of how much they actually worked collectively versus individually to accomplish the task. Some teams met more frequently to coordinate their assignments, while others distributed the sub-tasks to a greater degree and worked semi-independently. It may not be surprising, therefore, that the collective efficacy-performance correlation, based on instructor-rated performance, was in the range of correlations found in task groups employing relatively low to medium levels of task interdependence[4].

We had observed that, like collective efficacy, cohesion strongly predicted team-rated performance; it also produced a larger correlation with instructor-rated performance than did collective efficacy. It may be that cohesive groups are motivated to work more closely together and put more effort into team tasks, resulting in better process and products. It may also be that cohesive groups perform better, in part, because of the sense of collective efficacy that they foster. To test this latter possibility, we performed supplementary analyses in which the effects of collective efficacy were partialled from cohesion-performance relationships. The results suggested that controlling for collective efficacy only partly reduced the relation of cohesion to performance. Other group process variables (e.g., effort expenditure, quality of communication, perseverance despite setbacks) might, therefore, be examined in future research to clarify the specific mechanisms through which cohesion and collective efficacy affect performance.

Interpretation of our findings should take into consideration the study's design limitations. In particular, though the findings are consistent with our conceptualization of the antecedents and consequences of collective efficacy, cause and effect relationships cannot be inferred given the largely cross-sectional nature of our design. Future research employing longitudinal and experimental designs is needed to better establish the nature of the relationships between variables that are assumed to inform, and flow from, collective efficacy. Several other directions for future research might also be cited. First, since leaders can have a disproportionate impact on group processes and productivity, it would be valuable to expand study of leadership behavior relative to collective efficacy. For example, what tactics do successful sports coaches use to enhance a team's confidence in its capabilities, and which of these tactics might be translated for use with other types of teams, such as student project teams?

Second, in addition to task interdependence, what other variables or conditions might moderate collective efficacy-performance relationships? For example, it may be that collective efficacy relates to performance more strongly when (a) groups are smaller, (b) members more fully agree on their perceptions of the group's efficacy[13], and (c) adequate task resources are available to the group. Such dynamics may enable communication and coordination of group activities. Third, it would be valuable to devote greater study to how student project teams, in particular, can best be composed and facilitated. For example, should intentional efforts be made to form groups in which members have complementary skills or represent diversity with respect to gender, race, or

other individual difference dimensions? What strategies can best mitigate "social loafing" in project teams?

Although they should be viewed as preliminary, the present results, in concert with prior research and theory[14,15], hold several implications for instructional efforts to boost team functioning and to maximize student learning of technical concepts and interpersonal skills within project teams. In particular, realizing the role that collective efficacy may play in project teams, course instructors might attend to issues of group cohesion (which may impact collective efficacy); provide accurate but encouraging ongoing feedback on group performance; help teams to redefine and learn from smaller successes and failures; scale complex tasks down into their sub-parts; encourage efficacy-boosting performance attributions; and, where necessary, restructure ineffective teams. Team skills may require an intentional focus by instructors; it cannot simply be assumed that students with good math, science, and technical abilities (and self-efficacy) will automatically function well in teams.

In sum, the present findings support for the utility of collective efficacy as a concept for understanding student project team functioning. They also support the need for further study of group learning and productivity processes in the context of academic and career development. Student teams are becoming an increasingly popular educational medium in engineering, business, and other academic fields, mirroring the prominence of teams in the workplace. Thus, it is important to examine theoretical mechanisms, like collective efficacy, that may both shed light on team functioning under natural conditions and suggest developmental or remedial steps for promoting effective teamwork.

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