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Transformational Leadership, Initiating Structure, and Substitutes for Leadership: A Longitudinal Study of Research and Development Project Team Performance

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Transformational leadership, initiating structure, and selected substitutes for leadership were studied as longitudinal predictors of performance in 118 research and development (R&D) project teams from 5 firms. As hypothesized, transformational leadership predicted 1-year-later technical quality, schedule performance, and cost performance and 5-year-later profitability and speed to market. Initiating structure predicted all the performance measures. The substitutes of subordinate ability and an intrinsically satisfying task each predicted technical quality and profitability, and ability predicted speed to market. Moderator effects for type of R&D work were hypothesized and found whereby transformational leadership was a stronger predictor of technical quality in research projects, whereas initiating structure was a stronger predictor of technical quality in development projects. Implications for leadership theory and research are discussed.

Keywords: leadership, R&D management, project teams, substitutes for leadership

Does leadership matter? Are there substitutes for leadership that can better explain team performance? Has initiating structure been unfortunately neglected in the past decade? After some 7 decades of research on the topic, it may seem strange to ask if leadership matters, but whether leadership or substitutes for leadership better explains performance is a controversial matter for current research. One camp has argued that leader behaviors, especially transformational or transactional leadership, positively impact the performance of subordinates and their units (Barling, Loughlin, & Kelloway, 2002; Waldman, Ramirez, House, & Puranam, 2001). Dionne, Yammarino, Atwater, and James (2002), moreover, have suggested that findings for substitutes for leadership may even be "merely a statistical artifact, resulting from common-source bias" (p. 454). Others, however, have maintained that substitutes for leadership, such as the ability of subordinates or task feedback, offer their own explanations of subordinate performance separate from that of leadership (Jermier & Kerr, 1997; Podsakoff, MacKenzie, & Boomer, 1996a).

Although the empirical literatures concerning transformational leadership and substitutes for leadership are ample, lack of rigor has been a problem. Laboratory studies aside, the large majority of field studies have been cross-sectional in design, and common-method bias often has been a problem when performance has even been measured (Barling et al., 2002; Jermier & Kerr, 1997). The quality of performance measurement has been seen as critical to determining whether leadership matters (Dionne et al., 2002). Finally, Yukl (2002) noted that the transformational leadership literature has focused too narrowly on dyadic processes, and he called for greater attention to team-based study.

In contrast to the case of transformational leadership, the past decade has seen a serious lack of published studies of initiating structure and performance in organizations (Fleishman, 1998; Yukl, 2002). Judge, Piccolo, and Ilies (2004) called initiating structure a "forgotten one" of empirical leadership research since 1987, but their meta-analysis found significant relationships with subordinate and group–organization performance. They called for a renewal of interest in initiating structure research. The purpose of the present study was to test three important models of leadership—transformational leadership, initiating structure, and substitutes for leadership—in a multiorganizational field setting to determine their longitudinal effects on separate-source and objective team performance outcomes that are important to the actual organizations. Research and development (R&D) teams were chosen because they usually operate autonomously, with true team outcomes, and because, being worker paced, their performance can be substantially influenced by the leader's behavior and substitutes for leadership.

The seminal work on *transformational leadership*, sometimes known as charismatic leadership, was done by House (1977) and Burns (1978). Although transformational and charismatic leadership have differences, House and Aditya (1997) and Dvir, Eden, Avolio, and Shamir (2002), among others, have concluded that these differences are relatively minor, with a strong convergence among the empirical findings. The basic notion is that a transformational leader can create an impression that he or she has high competence and a vision to achieve success. Subordinates respond with an enthusiasm and commitment to the team's objectives. Bass (1985, 1998) extended this work to a theory of transformational leadership whereby the leader can inspire and activate subordinates to perform and achieve goals beyond normal expectations.

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Because R&D teams are often cross-functional, the transformational leader can convince members, via charisma and serving as a coach and mentor, to look beyond individual or functional orientations to the importance of a technological innovation or new product as a team outcome (Bass, 1985; Yukl, 2002). Burns (1978) and Bass (1985) have distinguished transformational leaders (who inspire through a vision) from transactional leaders (who use exchange relationships and monitoring). Bass (1985) postulated that leaders could be transformational, transactional, both, or neither in their leader behaviors.

Literature reviews of transformational leadership generally have found positive associations with follower motivations and self-rated performance (House & Aditya, 1997; Lowe, Kroeck, & Sivasubramaniam, 1996; Yukl, 2002). Relationships with separate-source measures of performance have had lower correlations. Recent research has continued the generally positive results for transformational leadership. Judge and Bono (2000) found transformational leaders to have higher effectiveness and more motivated and satisfied subordinates, and Waldman et al. (2001), in a longitudinal study, found that charismatic CEO leaders had higher financial performance under conditions of uncertainty but not under conditions of certainty. Studies with military samples have found positive support for transformational leadership and subordinate performance in the Israeli army (Dvir et al., 2002), the United States Army (Bass, Avolio, Jung, & Berson, 2003), and the Singaporean army (Lim & Ployhart, 2004). Podsakoff, MacKenzie, and Bommer (1996b) found that transformational leader behaviors were associated with subordinate job satisfaction and in-role performance, and Shin and Zhou (2003) studied Korean R&D employees and found that transformational leadership was positively related to subordinate creativity. In contrast to the literature supportive of transformational leadership, Shamir, Zakay, Breinin, and Popper (1998) found "only very partial support" (p. 387) for the effects of charismatic behaviors by Israeli army company leaders on their superior-rated performance. They noted that the subordinates were conscripts, and the organization was hierarchical—factors that could limit the effectiveness of charismatic leadership.

The primary component of transformational leadership has been charismatic leadership, in which subordinates are inspired to perform beyond normal expectations via a commitment to a vision and perception of competence provided by the leader (Bass, 1985; Pawar & Eastman, 1997; Yukl, 2002). In effect, subordinates have bought into a charismatic relationship with the leader that enables them to go beyond individual self-interests to focus on the team's outcomes. Subordinates, moreover, are motivated by a higher level of self-efficacy to persist in reaching more challenging goals (Conger & Kanungo, 1987; Waldman et al., 2001).

> *Hypothesis 1:* Charismatic leadership will positively predict project team performance.

Bass (1985) proposed intellectual stimulation as another component of transformational leadership that—although related to charisma—he saw as a distinct factor. Bass (1985) argued that a leader could be an intellectual stimulation to subordinates by acting as a teacher who prods and questions, and Conger and Kanungo (1987) saw the charismatic leader as one who engages in innovative behaviors that are counter to prevailing norms. Waldman, Javidan, and Varella (2004), moreover, found that intellectual stimulation allowed CEO leaders to provide a problem-solving component in addition to charisma. It is quite logical that R&D project teams would be helped in their performance by intellectual stimulation from a leader who might suggest an alternative way of approaching a problem or a different source of scientific and technological information.

> *Hypothesis 2*: Intellectual stimulation will positively predict project team performance.

A voluminous pre-1990 literature exists on the traditional leader behaviors of *initiating structure*, whereby the leader defines, directs, and structures the roles and activities of subordinates toward attainment of the team's goals (Bass, 1990; House & Aditya, 1997; Yukl, 2002). Judge et al. (2004), however, called initiating structure one of the "forgotten ones" of leadership research because of its absence in published studies since 1987, and their meta-analysis found initiating structure to have been an important predictor of performance at individual and group–organizational levels. They argued for its inclusion in future research, especially in studies with transformational leadership. Nadler and Tushman (1990), moreover, have argued that charismatic leadership must be complemented by initiating structure to provide detail to generate technological change.

> *Hypothesis 3:* Initiating structure will positively predict project team performance.

Contextual factors, such as the type of task, have received an increasing amount of attention as moderators of the relationship between transformational leadership and performance (Pawar & Eastman, 1997; Stewart & Barrick, 2000). Prior research on R&D teams has found that type of work—namely, research versus development—can be an important moderator between an independent variable, such as leader behavior, and project team performance (Elkins & Keller, 2003; Keller, 1992). Research projects usually have a longer time frame than development projects, require the use of scientific and technological information that often resides outside the project team, and generally deal with more radical technological innovations that go beyond existing knowledge than do the more focused incremental innovations of product development projects. It is therefore logical to expect transformational leadership to be more effective in research projects, in which charismatic leadership or intellectual stimulation can encourage bold and unconventional thinking that can generate new knowledge.

> *Hypothesis 4:* Type of R&D work will moderate the relationships of charismatic leadership and intellectual stimulation with project team performance, such that stronger relationships will occur in research projects than in development projects.

Because initiating structure emphasizes the leader's assignment of tasks and definition of roles for subordinates, it is also logical that it will be more effective in development projects, which usually entail incremental innovation, tend to have the needed knowledge residing within the project, and require the internal diffusion and coordination of such knowledge by task assignments among team members.

> *Hypothesis 5:* Type of R&D work will moderate the relationship of initiating structure with project team performance, such that a stronger relationship will occur in development projects than in research projects.

Kerr and Jermier's (1978) model laid the foundation for *substitutes for leadership* by identifying 13 characteristics that can substitute for the leader's behavior or neutralize the effects of leadership. Examples of substitutes include an intrinsically satisfying task or a subordinate's ability, training, and experience, and an example of a neutralizer is the spatial distance between leader and subordinate. The literature on substitutes is not extensive, but Podsakoff et al. (1996a) were able to identify 22 empirical studies on which to perform their meta-analysis, and they concluded that both leader behaviors and substitutes account for unique variance in subordinate attitudes and performance. In a separate study, Podsakoff et al. (1996b) found that transformational leadership and substitutes each explained unique variance in subordinate attitudes and in-role performance, consistent with their meta-analysis.

But the substitutes for leadership model has attracted some strong criticism. Yukl (2002) saw the research support as limited and the theory as having a weak and ambiguous rationale. Dionne et al. (2002) sampled 49 organizations and concluded that the substitutes for leadership provided no moderation or mediation effects of leadership and that many of the past "significant" results for substitutes were attributable to common-method bias. Even Jermier and Kerr (1997) lamented the strong reliance of the substitutes literature on cross-sectional research and called for longitudinal field research. Despite these criticisms, the importance of substitutes in the leadership literature and a need for a longitudinal field study requires the inclusion of substitutes to answer the question of whether leadership matters. Murry (1998) argued that substitutes can influence subordinate behaviors, and Tosi and Banning (1998) noted that the substitutes may have their strongest effects on performance at the group level.

As with most of the literature on substitutes, the present study selected those substitutes that had the best chance to predict performance in the environment of the particular study (Dionne et al., 2002). Because of their extensive prior experience and training, internal motivation, and interesting tasks, scientists and engineers working in R&D teams represent a key context in which substitutes for leadership can be especially relevant (Yukl, 2002). On the basis of this context, the substitutes chosen were ability (experience and training), professional orientation, spatial distance from supervisor, subordinate need for independence, task feedback, intrinsic satisfaction, and organizational formalization.

> *Hypothesis 6:* The substitutes for leadership of ability (experience and training), professional orientation, spatial distance, need for independence, task feedback, intrinsic satisfaction, and organizational formalization will each predict project team performance.

Method

Sample

The sample consisted of 118 project teams from five industrial R&D organizations engaged in the scientific instruments, semiconductor, energy, petrochemical, and aerospace industries. In addition to the 118 project leaders (100% response rate), 674 professional employees (91% response rate), each of whom was a member of only 1 project team, participated in the study. When the first set of performance measures were obtained 1 year later, all the project leaders were still leading their teams, and 17 professional employees (2.5%) had left. No project team lost more than 1 member. Eighty-two percent of the participants were men, 18% were women, and their average age was 35 years old. All the participants held a baccalaureate degree, and 74% held a graduate degree.

Measures

Leadership. Project team members rated their leader's behaviors on a 5-point response format ranging from 1 (*never*) to 5 (*always*). Ten items from the *charismatic leadership* scale (coefficient $\alpha = .84$) from Bass's (1985) Multifactor Leadership Questionnaire (MLQ) were used that had high factor loadings in Bass's report and were nonduplicative in their wording. The MLQ has been the primary instrument in research on transformational leadership dimensions (Tejeda, Scandura, & Pillai, 2001). *Intellectual stimulation* was measured by 3 items from the MLQ (coefficient $\alpha = .79$). (Because of space limitation in the questionnaire imposed by the participating organizations, only two transformational leadership dimensions were measured.) *Initiating structure* was measured by 6 items from the Leader Behavior Description Questionnaire—Form XII (Stogdill, 1963; coefficient $\alpha = .82$).

Substitutes for leadership. The Kerr and Jermier (1978) instrument was used by the team members to rate the seven substitutes for leadership chosen for this study. A 5-point response format ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) was used. All the scales had three items each, except for organizational formalization, which had five items. The seven substitutes (with coefficient alpha reliabilities given in parentheses) were ability (.73), professional orientation (.75), spatial distance from supervisor (.76), subordinate need for independence (.70), task feedback (.76), intrinsic satisfaction (.78), and organizational formalization (.80).

Project team performance. In discussions with management, three criteria for project team performance were identified that were similar to those used by the firms for their internal evaluations of projects: *technical quality*, *schedule performance*, and *cost performance* (all scored in the direction of better performance). One year after the leadership variables were measured, a panel of 3–7 managers in each firm—all one level above the project team leaders—rated each criterion on a 5-point response format ranging from 1 (*very low*) to 5 (*very high*). Interrater reliabilities, computed as intraclass correlation coefficients (ICCs [1,k]; Shrout & Fleiss, 1979), were .74, .74, and .71, respectively, for technical quality, schedule performance, and cost performance. The 1-year time lag was used because of the time needed for leadership and interpersonal processes of R&D teams to transform scientific and technological information into innovations (Harrison, Price, Gavin, & Florey, 2002).

Five years after the leadership, moderator, and control variables were measured, two actual, objective measures of project team performance were obtained from company records for the 52 project teams that had a new product that made it to market. (Sixty-six teams did not have a product that made it to market.) The 5-year time lag was needed because of the considerable amounts of time, effort, and resources needed to move a technological innovation through a firm and launch it as a new product in the market (Sheremata, 2000). These measures were determined in discussions with management, and they were similar to what was used internally to evaluate their firm's R&D efforts that reached the market. The first measure of success in the market was *profitability*, or the average annual contribution to company profit for each new product relative to the average profitability of all new products in the firm. This profit measure was determined by subtracting variable costs from the sales revenue for each product. Fixed costs, such as depreciation or long-term debt payments, were not considered (Higgins, 2004). Each product's average annual profitability was divided by the average profitability of all the new products in the firm because of the diversity of industries represented in the sample.

Because of the importance of first-mover advantage, the other measure of success for technological innovations that made it to market was *speed to market* (Lee, Smith, Grimm, & Schomburg, 2000). This variable was measured by the number of months needed to bring a product to market relative to the development time of all new products in the firm (reverse scored). Development time was measured as starting with the first meeting of the project team and ending when the product was launched into a market for sale (Eisenhardt & Tabrizi, 1995). The time to market in months for each product was divided by the average time to market for all the new products in the firm, because speed to market differed significantly across the relatively fast-cycle industries of semiconductor and scientific instruments compared with speed to market in the energy, aerospace, and petrochemical industries.

One moderator and two control variables also were measured at the time that the leadership variables were measured. *Type of R&D work* was measured as a moderator by a one-item question that asked the project team members to classify the team's work as one of the following: basic or nonmission research to create broad-based new knowledge, applied or mission-oriented research that creates new knowledge for application to a particular problem, new product development that takes existing knowledge and produces a new product, or technical service or minor modification of an existing product. Because there were only two basic research projects, basic and applied research projects were combined and called *research projects* ($n = 40$). Further, because there were only two technical service projects, new product development and technical service projects were combined and called *development projects* ($n = 78$). Before the moderated regression analyses were conducted, the continuous variables of transformational leadership and initiating structure were centered prior to the creation of the interaction term, as suggested by Cohen, Cohen, West, and Aiken (2003). (Centering can reduce any multicollinearity between a variable in the interaction term and the interaction term itself.) Because (with 1 exception) the only projects that made it to market 5 years later were development projects, the moderator hypotheses (Hypotheses 4 and 5) could only be tested with the 1-year-later performance measures, not with speed to market or profitability.

Two control variables often used in the literature on R&D teams were chosen. Actual *team size* ($M = 8.24$, range = 4–16) was included as a control variable because prior findings have shown it to be related to internal team communication, team performance, and leader behaviors (Ancona & Caldwell, 1992; Bass, 1990). Also, *tenure in the project team* of members (in number of months) was included as a control variable because of its associations in the prior literature with the development of interpersonal relationships and knowledge bases in the team as well as innovative outcomes (Carroll & Harrison, 1998; Sheremata, 2000). As suggested by Ancona and Caldwell (1992), the coefficient of variation (standard deviation divided by the mean) was used for team tenure.

Analysis and Procedures

All variables were aggregated to project team means because this was the unit of analysis. To justify this aggregation, a one-way analysis of variance was conducted on each of the variables to determine whether between-teams differences were significantly greater than within-team differences (Chan, 1998). A Bartlett–Box F test for homogeneity of variance was also calculated. All of the variables passed these tests beyond the .05 level of significance. Further, for the three leadership variables, the seven substitutes for leadership variables, and type of R&D work, a within-team correlation (r_{wg}) was computed to assess the amount of agreement by team members (James, Demaree, & Wolf, 1984). These mean r_{wg} values ranged from .77 to .84, which indicated good agreement. ICC(1), a form of interrater reliability, and ICC(2), a measure of group mean reliability, were also calculated for these variables (Klein & Kozlowski, 2000). The range of values for ICC(1) was from .43–.51, and the range for ICC(2) was .70–.77, which suggested good within-group agreement.

The same data-collection procedures were used in all five organizations. Groups of 25–60 participants at a time completed the questionnaire during normal business hours at their work sites. The researcher was the only nonparticipant present when the questionnaires were completed, and the researcher and the management of each firm guaranteed confidentiality of all information. Only summary information was reported back to the firms that participated in the research.

Results

The means, standard deviations, and a correlation matrix are reported in Table 1. (Company–industry differences were analyzed via the dummy-variable coding procedures and analyses described in Cohen et al. [2003]. None of the results in the present study were significantly affected by company–industry differences.) Charismatic leadership and intellectual stimulation had a correlation of .72. Although Bass (1985) distinguished between the emotional and intellectual components of transformational leadership, prior studies also found very high correlations among these scales and, in fact, combined them into one transformational factor (Barling et al., 2002; Bass et al., 2003; Judge & Bono, 2000; Turner, Barling, Epitropaki, Butcher, & Milner, 2002). The combination can also be justified conceptually: Bass (1985) noted that leaders who provide intellectual stimulation as mentors can also be perceived as having the emotional charismatic characteristics of competence and vision. Finally, a combination would prevent a multicollinearity problem in multiple regression analyses (Cohen et al., 2003). Therefore, charismatic leadership and intellectual stimulation were combined to form a single variable called *transformational leadership*.

After the formation of the transformational leadership variable, it, the seven substitutes for leadership variables, and initiating structure had a median absolute intercorrelation of .12, a maximum correlation of .31, and maximum variance-inflation factor of 2; hence, multicollinearity was not a severe problem that would preclude interpretation of the regression analyses (Neter, Kutner, Wasserman, & Nachtsheim, 1996). A confirmatory factor analysis of the team member data, moreover, suggested that the nine-factor solution provided a good fit, $\chi^2(51, N = 674) = 254.77, p < .01$; goodness-of-fit index = .94; comparative fit index = .92; root-mean-square error of approximation = .06.

To maintain good power and validity of a multiple regression analysis, Cohen et al. (2003) recommended that only the central and nonredundant independent variables be included. Hence, the following four substitutes for leadership variables that had no significant correlation with any of the project performance variables were dropped from the regression analyses: professional orientation, spatial distance, need for independence, and task feedback. The three substitutes for leadership (i.e., ability, intrinsic satisfaction, and organizational formalization) that were correlated with any of the performance variables were kept.

Table 2 reports the regression results used to test the hypotheses for the 1-year-later project performance variables, and Table 3

Table 1
Means, Standard Deviations, and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Charismatic leadership	3.21	0.81	—																	
2. Intellectual stimulation	2.97	0.95	.72**	—																
3. Ability	3.06	1.03	−.09	−.15	—															
4. Professional orientation	2.90	0.87	−.23*	−.17	.12	—														
5. Spatial distance	2.68	0.60	.10	−.03	.15	.22*	—													
6. Need for independence	3.14	0.91	.07	−.04	.31**	−.22*	−.09	—												
7. Task feedback	3.10	0.83	−.12	−.26**	−.04	.00	.01	.27**	—											
8. Intrinsic satisfaction	3.21	1.00	.07	−.04	.12	−.05	.13	−.04	.11	—										
9. Organizational formalization	2.77	0.78	.26**	.09	−.13	−.18*	−.02	−.02	.01	.05	—									
10. Initiating structure	3.18	0.57	.19*	.19*	−.19*	−.10	.05	.04	−.12	−.14	.26**	—								
11. Team size	8.24	3.97	−.06	−.13	.04	−.12	−.12	.11	.02	−.15	.17	.16	—							
12. Team tenure[a]	0.47	0.14	.13	−.03	−.03	.09	.13	.08	.12	.18*	.10	−.03	.11	—						
13. Type of R&D[b]	1.77	0.58	.06	.08	.07	.11	.11	.00	−.03	.00	.03	.24**	.12	−.03	—					
14. Technical quality	3.30	0.99	.46**	.40**	.18*	−.04	.06	−.01	.10	.30**	.20*	.23*	.08	.05	.05	—				
15. Schedule performance	3.17	0.78	.30**	.27**	.11	−.03	.14	.00	.10	.19*	.16	.30**	.08	.08	.35**	.38**	—			
16. Cost performance	3.06	0.72	.24**	−.13	.09	.03	.10	.11	.09	.18*	.18*	.27**	.09	.01	.18*	.30**	.32**	—		
17. Profitability	1.00	0.72	.42**	.28*	.20	.16	.08	.11	.20	.23*	.19	.34*	.11	.15	—	.55**	.57**	.11	—	
18. Speed to market	1.00	0.69	.30**	.18	.11	.18	.04	−.05	.09	.16	.09	.39**	.21	.14	—	.33**	.38**	.21	.32*	—

Note. $N = 118$ project teams, except for profitability and speed to market data ($n = 52$).
[a] The coefficient of variation (standard deviation divided by the mean) was used. [b] Type of R&D was coded as follows: research projects ($n = 40$) = 1; development projects ($n = 78$) = 2.
* $p < .05$. ** $p < .01$.

Table 2
Regression Results for 1-Year-Later Project Performance Variables

Variable	Technical quality			Schedule performance			Cost performance		
	β	ΔR^2	$F(10, 107)$	β	ΔR^2	$F(10, 107)$	β	ΔR^2	$F(10, 107)$
Control									
Team size	.10	.00	1.27	.03	.00	0.30	.07	.00	1.45
Team tenure	−.04	.00	1.09	.04	.00	1.62	−.05	.00	1.23
Independent									
Transformational leadership (A_1)	.42**	.12	10.21**	.26**	.05	5.77**	.23**	.04	4.80**
Initiating structure (A_2)	.23**	.04	4.73**	.23**	.04	5.24**	.23**	.03	3.86**
Ability	.24**	.04	5.08**	.14	.01	1.77	.13	.01	1.86
Intrinsic satisfaction	.32**	.05	5.81**	.20*	.02	1.72	.21*	.02	1.80
Organizational formalization	.07	.00	1.88	.04	.00	0.80	.07	.00	1.51
Moderator									
Type of R&D (B_1)	−.06	.00	1.19	.27**	.05	6.15**	.09	.00	1.64
$A_1 \times B_1$	−.22*	.04	4.11**	−.13	.01	1.61	.08	.00	1.80
$A_2 \times B_1$	.20*	.04	3.90**	.05	.00	0.99	.10	.01	1.69
Overall *F*		10.65**			5.58**			4.87**	
R^2		.44			.32			.26	
Adjusted R^2		.39			.26			.19	

Note. N= 118 project teams. The ΔR^2 and *F* values were derived from hierarchical regression analyses.
* $p < .05$. ** $p < .01$.

presents the regression results for the 5-year-later variables of profitability and speed to market. These tables report full-equation standardized regression coefficients (βs) for all independent, control, and moderator variables. The moderator analysis reported in Table 2 was conducted with the interaction term entered last. Separately, a series of hierarchical regression analyses were conducted to determine unique variance explained (ΔR^2) whereby each variable was tested with two regression analyses: one without the variable and one with the variable added as the last step of the regression. Tables 2 and 3 report the ΔR^2s to the dependent variables and related *F* values from these hierarchical regression analyses.

Because charismatic leadership and intellectual stimulation were combined into transformational leadership, Hypotheses 1 and 2 were, in effect, combined. As can be seen in Table 2, transformational leadership strongly predicted technical quality, and it also predicted schedule and cost performance. Table 3 shows that transformational leadership also was a strong predictor of profitability and speed to market. Regarding Hypothesis 3, Table 2 reports that initiating structure did predict all three 1-year-later performance variables, and Table 3 shows that it predicted both 5-year-later performance variables as well. Initiating structure, moreover, was an especially good predictor of speed to market, equal to the predictive power of transformational leadership.

Type of R&D work was predicted to moderate the relationship of transformational leadership with performance in Hypothesis 4, such that stronger relationships would occur in research projects than in development projects. Table 2 reports a significant moderator effect for technical quality but not for schedule or cost performance. Hypothesis 5 predicted a moderator effect for the

Table 3
Regression Results for 5-Year-Later Profitability and Speed to Market

Variable	Profitability			Speed to market		
	β	ΔR^2	$F(7, 44)$	β	ΔR^2	$F(7, 44)$
Control						
Team size	.08	.00	0.57	.15	.01	2.06
Team tenure	.02	.00	1.08	.04	.00	1.34
Independent						
Transformational leadership	.41**	.10	9.43**	.33**	.07	7.77**
Initiating structure	.32**	.04	5.86**	.39**	.07	8.16**
Ability	.29**	.05	6.78**	.18	.00	1.96
Intrinsic satisfaction	.23*	.04	6.00**	.20*	.03	2.92*
Organizational formalization	.05	.00	1.39	−.08	.00	0.99
Overall *F*		9.07**			5.36**	
R^2		.43			.35	
Adjusted R^2		.34			.25	

Note. $N = 52$ project teams. The ΔR^2 and *F* values were derived from hierarchical regression analyses.
* $p < .05$. ** $p < .01$.

relationship between initiating structure and project performance, such that a stronger relationship would occur for development projects than for research projects. The results in Table 2 show a significant moderator effect for technical quality but not for schedule or cost performance. The significant moderator effects were further investigated in separate sets of regressions for research-project and development-project subgroups. These results were plotted for 1 standard deviation above and below the mean of the within-group regression equations for transformational leadership and initiating structure and 1-year-later technical quality (Cohen et al., 2003). Figure 1 shows that transformational leadership predicted higher technical quality mainly for research projects, whereas Figure 2 indicates that initiating structure predicted higher technical quality primarily for development projects (as suggested by Hypotheses 4 and 5, respectively).

Because four of the substitutes for leadership variables were dropped from the regression analyses, Hypothesis 6 was tested for the three remaining variables and stated that ability, intrinsic satisfaction, and organizational formalization will each predict project team performance. Table 2 shows that ability predicted 1-year-later technical quality, and Table 3 reports that it predicted 5-year-later profitability. These tables also show that intrinsic satisfaction predicted 1-year-later technical quality and schedule and cost performance (regression coefficients only) as well as 5-year later profitability and speed to market. Organizational formalization (and the four dropped substitutes variables) did not predict any of the project performance variables.

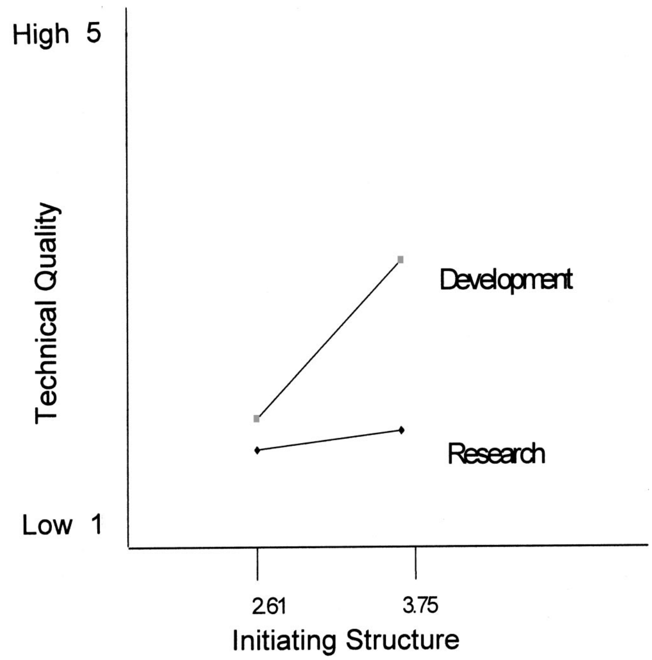

Figure 2. The relationship between initiating structure and technical quality for research and development projects. The numbers 2.61 and 3.75 are 1 standard deviation above and below the mean (3.18) for the initiating structure scale for research and development subgroups.

Discussion

The results of this study provide important evidence that transformational leadership, initiating structure, and two of the substitutes for leadership (i.e., ability and intrinsic satisfaction) matter to R&D project team performance over time. Hence, there is something for most everyone in the debate over whether leadership or substitutes for leadership are important variables for leadership-theory building and team performance. An important distinction of the present study is that its research design was more rigorous than those used in the large majority of the existing field studies on leadership. The present study had multiple organizations with a range of R&D activities and a longitudinal, team-based design with performance measures important to the organizations. The 1-year-later measures were from a source separate from that of the independent, moderator, and control variables, and the 5-year-later measures were actual, objective measures of R&D market-based project performance.

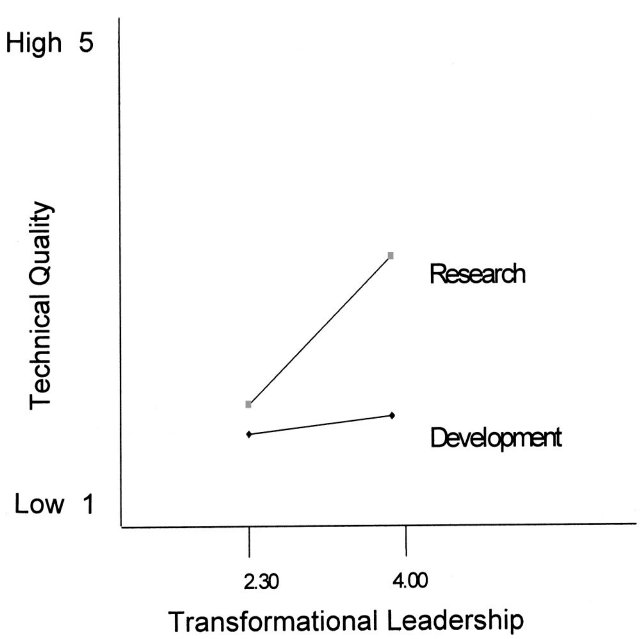

Figure 1. The relationship between transformational leadership and technical quality for research and development projects. The numbers 2.30 and 4.00 are 1 standard deviation above and below the mean (3.15) for the transformational leadership scale for research and development subgroups.

Because of the longitudinal design, the results are less susceptible to the concern that subordinate perceptions of charisma or inspiration may be attributions made about a leader that follow from good performance rather than charisma or inspiration preceding good performance (House & Aditya, 1997; Pawar & Eastman, 1997; Yukl, 2002). The similar concern about common-method bias for transformational leadership findings should also be ameliorated by the present study. Further, because of the separate-source and objective measures of performance, the results that show unique variance in performance explained by the substitutes for leadership of ability and intrinsic satisfaction are immune to the charge made by Dionne et al. (2002) of past such results that they have been the product of common-method bias. These results suggest that the "substitutes" are additives rather than substitutes per se. The results are also consistent with the observation by Tosi and Banning (1998) that the effects of substitutes on performance measures are generally greater at the team level of analysis than at the individual level.

Because initiating structure predicted unique variance in all five of the performance measures, the results suggest it is time to bring initiating structure back into models of leadership for teams. At least in the realm of R&D project teams, initiating structure may be an important complement to transformational leadership in providing the detail and direction that subordinates need and may not get from transformational leadership. Moreover, the correlation of only .19 between initiating structure and transformational leadership in the present study underscores their lack of overlap.

The results also suggest that leadership is a complex, multidimensional process, as evidenced by the moderator effects of type of R&D work and the fact that the independent variables had differential predictions of the dependent variables. To wit, transformational leadership was more important for research projects than it was for development projects. The inspiration and intellectual stimulation effects of transformational leadership were likely more effective in research projects, which usually deal with more radical innovations that require originality and the importation of knowledge from outside the project team. Further, initiating structure was more effective in development projects, in which the focus is on incremental innovations and modifications of existing products, more of the needed scientific and technological information resides within the project team, and the leader tends to direct tasks to achieve product development. These findings are supportive of a contingency approach to transformational leadership in R&D project teams.

A limitation of the present study is that no data were collected on the independent, moderator, or control variables over the 5-year time that performance measures were collected. (As noted in the *Sample* section, the turnover at the time the 1-year-later performance measures were obtained was 0% for project leaders and 2.5% for team members.) In effect, it is not known what happened to relationships among team members or their leaders over the time of the study. Future research using a laboratory design or a multiple-case method field study may be better suited to provide this explanatory information.

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