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Enhancing the Transfer of Computer-Assisted Training Proficiency in Geographically Distributed Teams

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The authors examined factors that determine whether knowledge gained from computer-assisted (i.e., technology-based) team training in a geographically distributed team (GDT) context transfers to organizational results. They examined the moderating effects of team trust, technology support, and leader experience on the relation between teams' average individual training proficiency on a computer-assisted (i.e., CD-ROM-based) training program and team performance as assessed by team customer satisfaction ratings. Using data collected from 40 GDTs in a high-technology company, the authors found that the relation between teams' average training proficiency and team performance was complex and moderated by several factors. In particular, teams' average training proficiency had a positive association with customer satisfaction when GDTs were higher, rather than lower, in both trust and technology support and when team leaders had longer, rather than shorter, levels of tenure with their specific team.

Keywords: team training, geographically distributed teams

Over the last 20 years, organizations have continued to use work teams to accomplish tasks (Kozlowski & Bell, 2003). Accompanying the cost of implementing teams is the investment to train team members and leaders in teamwork skills. Estimates of annual training costs in the United States run as high as $200 billion (Salas & Cannon-Bowers, 2001), yet researchers have estimated that only 10% of training expenditures result in transfer of training to actual jobs (Georgenson, 1982). *Transfer of training* is defined as the degree to which trainees apply the training knowledge, skills, and attitudes to their job (Baldwin & Ford, 1988). Further, although researchers have reported conflicting results of team training since the 1960s, the field has gained little ground in understanding why team training sometimes improves team performance and other times does not (see Salas, Dickinson, Converse, & Tannenbaum, 1992, for a review). Although a vast literature on training and development exists, much of it focuses on individual learning and transfer (Kozlowski, Brown, Weissbein, Cannon-Bowers, & Salas, 2000). Thus, there is a lack of attention to the influence of contextual factors at the work team, subunit, and organizational levels (Kozlowski & Salas, 1997). Researchers have not done enough to understand the underlying dynamics of team training transfer (Salas & Cannon-Bowers, 2001), particularly in emerging forms of collaboration, such as geographically distributed teams (GDTs; Bell & Kozlowski, 2002b).

Besides a dominant focus on individual-level training transfer, a second limitation is that contextual factors relevant to specific training content have rarely been studied. Kozlowski and Salas (1997, p. 279) pointed out that most research has examined general supportive climate (i.e., distal) factors and ignored training content (e.g., Russell, Terborg, & Powers, 1985). In the few cases in which investigators studied relevant support variables (Fleishman, 1953; Rouiller & Goldstein, 1993; Tesluk, Farr, Mathieu, & Vance, 1995), they accounted for unique variance in transfer behavior beyond learning. A third limitation is the lack of attention to more recent technological advances in training distributed teams. Designed to be readily available and used at a distance, these methods have included simulations and behavioral modeling delivered via the Internet, CD- or DVD-ROMs, or a local area network. Because they are relatively new, research has been sparse as to their effectiveness (Kozlowski & Bell, 2003). A final limitation is that, when assessing supportive work environment characteristics, researchers have typically used self-report, perceptual trainee reactions rather than organizational results (Baldwin & Ford, 1988).

To address these limitations, we examine factors that determine whether knowledge gained from computer-assisted (i.e., technology-based) team training in a GDT context transfers to organizational results. We focus on teams' *average training proficiency*, which refers to the extent that a team's individual members, on average, acquire the intended knowledge from training (cf.

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Barrick & Mount, 1991). Our research question is what factors encourage or inhibit the relation between teams' average training proficiency and team effectiveness in a GDT context. Thus, we (a) theoretically specify proximal team training transfer facilitators, including both team and work environment characteristics, that are tied specifically to the nature of training content; (b) examine the extent to which knowledge from a technology-based team training program is associated with team effectiveness; (c) examine an organization using GDTs, a form of collaboration that is increasingly used worldwide (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002); and (d) use actual team performance to more rigorously assess team training transfer (i.e., what Kirkpatrick, 1959a, 1959b, 1960a, 1960b, referred to as Level 4 or results criteria) rather than less rigorous, perceptual trainee reactions (Tannenbaum & Yukl, 1992).

Investigating the Gap Between GDT Training Proficiency and Performance

In an attempt to explain the lack of training transfer in organizations, researchers have pointed to the need to understand how training programs are embedded in organizational contexts (Kozlowski et al., 2000). An increasingly popular context of interest in organizations is GDTs (Driskell, Radtke, & Salas, 2003; Kayworth & Leidner, 2001; Maznevski & Chudoba, 2000; Montoya-Weiss, Massey, & Song, 2001), typically defined as groups of geographically and/or organizationally dispersed coworkers who use a combination of telecommunications and information technologies to accomplish a variety of critical tasks (Townsend, DeMarie, & Hickson, 1998). Given the nature of many of these teams—geographically dispersed and linked by technology-mediated communication—GDT training is often conducted electronically (Bell & Kozlowski, 2002a). This feature has implications for the three training inputs—training design, trainee characteristics, and the work environment—identified by Baldwin and Ford (1988) that affect training transfer. Few studies have included more than one type of training input simultaneously, and the field needs to do more to understand how various types of input factors work together to determine training transfer (Ford & Weissbein, 1997). Responding to calls for combining multiple types of training inputs, we assess the moderating effect of two of the three types of characteristics identified by Baldwin and Ford (i.e., trainee characteristics and work environment factors), and we adapt their framework for the team level of analysis by examining team (rather than individual trainee) characteristics. Team characteristics include properties of the team as a whole rather than those of specific individuals within the team.

Although it appears axiomatic that factors at the team level must be aligned with training objectives, researchers have rarely studied contextual factors that are relevant to the specific training content (Kozlowski & Salas, 1997). In our study, the objective of the training is to enhance *teamwork skills*, thereby enabling team members to deliver better customer service through teamwork. Thus, our choice of relevant support elements that facilitate the relation between technology-based teamwork training and GDT team performance was based on an extensive review of the GDT literature. In particular, we focused on factors that previous researchers identified as important to enhancing teamwork in GDTs (Bell & Kozlowski, 2002b; Cohen & Gibson, 2003). First, the *trust* that fellow members will accept new ideas even when such ideas may be counter to existing team norms should facilitate teamwork (Jarvenpaa, Knoll, & Leidner, 1998; Salas et al., 1992). Second, GDTs often communicate via information technology—E-mails, teleconferences, or videoconferences. Thus, effective teamwork likely depends on accessibility to *technology support* (Hinds & Weisband, 2003). Finally, *leadership experience* should help teams identify opportunities to use skills mastered in training for teamwork (Kayworth & Leidner, 2001). Although the list is not exhaustive, our moderators represent highly relevant variables in the GDT context. We now turn to the theoretical logic for trust as a team characteristic moderating the average training proficiency–performance relation and then discuss work environment characteristics (i.e., technology support and leadership experience).

Trust

At the team level, *collective trust* is defined as

> a common belief among a group of individuals that another individual or group (a) makes a good faith effort to behave in accordance with any commitments . . . (b) is honest in whatever negotiations preceded such commitments and (c) does not take excessive advantage of another even when the opportunity is available. (Cummings & Bromiley, 1996, p. 303)

Although not all studies have supported the team trust–performance link (Dirks, 2000), most have found that trust and team performance were positively related in a variety of different teams (Corbitt & Martz, 2003; Erdem & Ozen, 2003; Erdem, Ozen, & Atsan, 2003; Hyatt & Ruddy, 1997; Jarvenpaa & Leidner, 1999; Porter & Lilly, 1996). Cohen and Gibson (2003) included trust as a key enabling condition in their GDT model. Jarvenpaa et al. (1998; Jarvenpaa & Leidner, 1999) found that teams that were high, rather than low, in trust were more capable of managing uncertainty, complexity, and expectations.

Team trust likely moderates teams' average training proficiency–performance relation. First, enhancing teamwork depends, in part, on members' ability to supplement, build on, and exchange information about their new skills (Cohen & Gibson, 2003; Salas et al., 1992). Such exchanges are less likely in teams with low, rather than high, trust. For example, members in low-trust, rather than high-trust, teams are not as likely to communicate, cooperate, and engage in teamwork behaviors (Gibson & Manuel, 2003; Jones & George, 1998). Second, in teamwork training, team members will likely learn new ways to communicate, resolve conflict, or problem solve and make decisions (Salas et al., 1992). These new behaviors may violate team norms and produce undesirable conflict (Hinds & Bailey, 2003). Team members in high-trust, rather than low-trust, teams will be more willing to try new behaviors because the team will view violations of existing norms as efforts to improve team performance (Edmondson, 1999). Thus, we predict the following:

> *Hypothesis 1:* GDTs' average training proficiency and team performance will be more strongly positively related when there is higher, rather than lower, trust among GDT members.

Technology Support

Technology support refers to the extent to which team members have both (a) sufficient technology tools to communicate with

dispersed members and (b) the ability to effectively use the tools to communicate over space and time (King & Majchrzak, 2003). Such tools range from widely used technologies, such as E-mail and instant messaging, to more team-oriented applications (known as *groupware*) and other group decision support systems that make electronic brainstorming, decision-making, and problem-solving tasks possible without face-to-face contact (Townsend et al., 1998). Reflecting the importance of team context, Cohen and Gibson's (2003) model includes technology support as a key component, as do others (Bell & Kozlowski, 2002b; Griffith & Neale, 2001; Griffith, Sawyer, & Neale, 2003).

For several reasons, transfer of teamwork training is less likely to occur in teams with low, rather than high, technology support. First, technology support enables GDT members to discuss aspects or issues raised in teamwork training that are critical for developing new skills (Bikson, Cohen, & Mankin, 1999; Salas et al., 1992). Technology tools can archive training knowledge and transfer experiences so team members can access information in a timely manner (Gibson & Vermeulen, 2003). Cramton (2001) found that differences in the speed of access to information hampered teamwork in GDTs. Second, technology support can help team members apply teamwork training. Given that certain technologies are appropriate for particular tasks, teams that are supported with a broader array of communication technologies and are aware of how to best use available technology depending on the task at hand will be better able to apply the teamwork skills they have acquired through training when engaged in problem solving and making team decisions (Blackburn, Furst, & Rosen, 2003). Thus, we predict the following:

> *Hypothesis 2:* GDTs' average training proficiency and team performance will be more strongly positively related when there is higher, rather than lower, technology support.

Leadership Experience

Researchers recognize team leadership as key for work team effectiveness (Kozlowski & Bell, 2003), and GDTs are no exception (Kayworth & Leidner, 2001; Tyran, Tyran, & Shepherd, 2003). Cohen and Gibson (2003) included team leadership in their GDT model, and Bell and Kozlowski (2002b) called for more attention to leadership research in GDT contexts. Support at the team level is critical for training transfer (Facteau, Dobbins, Russel, Ladd, & Kudisch, 1995; Tesluk et al., 1995; Tracey, Tannenbaum, & Kavanagh, 1995; Tziner, Haccoun, & Kadish, 1991). One type of team-level support is external team leaders (i.e., team supervisors who are not also members of teams; Gibson & Vermeulen, 2003). Team leaders with more, rather than less, leadership experience with the particular teams they lead (in contrast to general team leadership experience) are more likely to facilitate teamwork training transfer.

First, because team transfer climate is specific to each training program, successful transfer requires an ongoing partnership between team leaders and members (Smith-Jentsch, Salas, & Brannick, 2001, p. 290). If team leaders have little familiarity with their members or their team's unique experiences, this partnership is less likely to exist. Experienced team leaders better appreciate individual team members' personality, work style, and motivation. Thus, they are better able to coach and support their teams to develop teamwork skills learned in training (Kayworth & Leidner, 2001). Second, successful GDT leaders develop habitual routines, monitor environmental changes, and encourage team coherence (Bell & Kozlowski, 2002b). GDT leaders need to be proactive, anticipate problems, provide clear direction, and design backup plans to provide temporal buffering under changing environmental conditions (Bell & Kozlowski, 2002b; Tyran et al., 2003). Critical for teamwork training transfer, these behaviors are more likely to be exhibited by leaders who have had more, rather than less, experience with their particular teams (Wagner & Sternberg, 1985). In support of our logic, Shamir, Brainin, Zakay, and Popper (2000) found that unit leader tenure was positively related to demonstration of skills learned in military training. Thus, we predict the following:

> *Hypothesis 3:* GDTs' average training proficiency and team performance will be more strongly positively related when team leaders have longer, rather than shorter, team leader tenure.

Method

Sample

We conducted a field study to test the moderating effects of team and work environment characteristics on the relation between technology-based GDT average training proficiency and performance. In particular, we studied a high-technology service organization in the travel industry that had formally implemented GDTs. The organization developed, installed, and serviced computer travel reservation systems and owned a Web-based travel site. Members of each team were geographically dispersed across North America. Although many members worked from home offices, there were a few cases in which team members were located in the same office. However, all members were part of a broader, physically dispersed team. Because of their physical dispersion, time spent in the field by the majority of the team, and the high costs associated with assembling entire intact teams face to face, members communicated using telephones, voice mail, E-mail, and instant messaging. A total of 326 out of 388 team members responded, representing 40 teams, for an individual response rate of 84%. Teams ranged in size from 3 to 16 members (average size was 9 members), and over half the members in each team completed surveys. A total of 36 out of 40 team leaders responded to surveys, for a response rate of 90%. Table 1 shows demographic characteristics for both team members and team leaders in our sample. All analyses were conducted at the team level of analysis.

Procedure

All 40 teams met our criteria for selection: (a) a minimum team life span of 1 year (to ensure that members had time to complete training, use it, and develop at least minimum levels of the moderators, e.g., trust), (b) clear team identity (i.e., teams had names, and clear boundaries existed between the teams), and (c) the physical separation of team members (i.e., because we were interested in factors moderating the average training proficiency–performance relation in GDTs). We contacted each team member via E-mail to explain the survey purpose and logistics and included an embedded Web site link to an online survey.

Measures

Average training proficiency. We evaluated each team's average training proficiency using Team Tools Interactive (TTI; The Belgard Group,

Table 1
Demographic Characteristics of the Virtual Team Members and Team Leaders

Characteristic	Team members	Team leaders
Sex (%)		
Female	73.0	61.0
Age range (%)		
≤25	4.1	0.0
26–35	20.6	20.0
36–45	45.7	51.4
46–55	24.2	22.9
≥56	5.4	5.7
Race/ethnicity (%)		
Caucasian American	78.0	78.8
African American	5.9	12.1
Hispanic American	10.9	9.1
Asian American	4.2	0.0
Pacific Islander	1.0	0.0
Education (%)		
High school (or less)	9.4	0.0
Associate's degree	10.0	5.3
Technical degree	8.5	0.0
Some college (beyond associate's)	30.3	23.7
Bachelor's degree	38.2	63.2
Graduate degree	3.6	7.9
Organizational tenure (mean years)	9.8	10.5
Team member tenure (mean years)	2.0	
Team leader tenure (mean years)		2.0
No. members per team (mean)	9.0	9.0

Note. Education represents highest degree earned.

Hillsboro, OR), a 15-module, commercially available CD-ROM-based training program designed to improve teamwork skills. TTI uses audio, video, and interactive scenarios to teach critical teamwork concepts. A detailed description of TTI is given in Table 2. At the end of each session, team members completed a multiple-choice test and received a percentage test score on the basis of their number of correct answers. Test scores on the modules were an indication of training proficiency and could range from 0% to 100%. We averaged the postmodule test scores of all individual members of each team across the 15 training modules to calculate an overall team-level measure of average training proficiency. Aggregating individual training proficiency scores by team is logical, given that our outcome variable (customer satisfaction, described below) was at the team level. However, because team members completed training modules and postmodule tests separately from each other, we did not expect convergence of test scores at the team level (representing an additive aggregation model; Chan, 1998). Thus, we did not use aggregation statistics for training proficiency. The mean team test score for all 40 teams was 86.2%, with a range of 78.5% to 93.9% (SD = 3.2%).

During the launch of GDTs, each team member received a CD-ROM kit containing the 15 training modules. Team members were asked to complete 4 modules per quarter over a year-long period. Each team could collectively choose which set of modules to complete depending on specific team needs, which is typical of learner-controlled training (Bell & Kozlowski, 2002a). The stated purpose of team training was to improve customer satisfaction. In a 2-year period before training, customer ratings of satisfaction with service and support fell from 79% to 68%, whereas competitor customer satisfaction rates remained unchanged. Thus, management hoped that providing teamwork skills training to the GDTs would help result in a turnaround in customer satisfaction.

Team performance. To assess the organizational results of average training proficiency, the organization used a balanced scorecard at the team and division levels. One important team component was *customer satisfaction* assessed through quarterly surveys from outside customers of each team. Customer satisfaction is clearly a team-level variable, given that, as previous researchers have argued, "individual-level service behavior will link to aggregate customer satisfaction" (Kozlowski et al., 2000, p. 184). Customers responded to a summary question, "What is your overall level of satisfaction with the service and support provided by this team?" Responses were made on a Likert-type rating scale from 1 = *not at all satisfied* to 5 = *completely satisfied*. The company considered the percentage of satisfaction ratings falling within the top two rating points (i.e., 4 = *somewhat satisfied* and 5 = *completely satisfied*) as an acceptable indicator of customer satisfaction. Customer satisfaction percentages were available for all 40 teams and were based on data collected 3 months after TTI concluded. The mean team customer satisfaction score for all 40 teams was 85.7%, with a range of 64% to 100% (SD = 7.8%).

Team trust. We assessed team trust using four items adapted from Jarvenpaa and Leidner (1999). Items for this and the other study scales are reported in the Appendix. Individual responses were aggregated to the team level. To test the validity of aggregating trust (Klein, Conn, Smith, & Sorra, 2001), we calculated the intraclass correlation coefficients (ICCs), ICC(1) and ICC(2). The resulting ICC(1) of .11 ($p < .01$; $\eta^2 = .20$) indicates that a reasonable proportion of the variance in individual responses on trust can be accounted for by team membership (James, 1982). The ICC(2) value of .71 indicates that the team means for trust were stable (Bliese, 2000). The reliability coefficient for team trust was .93.

Technology support. We assessed technology support with a three-item scale developed for this study (see the Appendix) using team-level informants (i.e., external team leaders). The reliability coefficient for technology support was .92.

Team leader experience. Again using team-level informants, we used a self-report indicator of team leader experience by asking team leaders how long they had been leading their team (i.e., tenure). Team leadership tenure ranged from 0 (i.e., brand new) to 120 months. On average, team leaders had been leading their teams for 25.0 months (SD = 28.8 months).

Control variables. The first control variable was *team size*, obtained from company records. Also, because team performance could depend on the amount of team training (i.e., some teams completed more modules than others) in addition to proficiency, we controlled for the total *number of training modules completed* by each team. The mean number of modules completed for all 40 teams was 11.0, with a range of 7 to 15 (SD = 2.3). Because *task interdependence* can influence team performance (e.g., Campion, Medsker, & Higgs, 1993), we controlled for it using Campion et al.'s (1993) three-item measure. In support of our decision to study actual teams (rather than individuals working independently), the mean level of task interdependence was 5.4 (on a scale ranging from 1 to 7), which was relatively high and consistent with other field studies of work teams (e.g., Cohen, Ledford, & Spreitzer, 1996; Cordery, Mueller, & Smith, 1991). The reliability coefficient for task interdependence was .69. Because the teams also varied on the extent to which they relied on electronically mediated communication (rather than meeting and working face to face; Kirkman & Mathieu, 2005), we assessed *electronic communication dependence* with an open-ended survey question to team members that read, "Think of a typical work week. Please indicate what percentage of your time is spent working virtually (no face-to-face contact with your team members, all electronic interaction)." The percentage of electronic communication dependence in our sample ranged from 35% to 98%, with a mean of 69.0% (SD = 16.9%). Checks for aggregation yielded acceptable values: ICC(1) = .12 ($p < .001$; $\eta^2 = .22$), and ICC(2) = .72. Because of its moderating role in previous research (Kirkman, Rosen, Tesluk, & Gibson, 2004), we controlled for electronic communication dependence as both a main and a moderator effect.

Table 2
Team Tools Interactive CD-ROM-Based Training Modules and Descriptions

Module name	Module description
1. Planning for action	Deciding who, what, when, and where for the work or project Creating a master plan for the work or project using flow charts Planning for contingencies and resources, creating a responsibility matrix
2. Building a Collaborative Team Environment	Enhancing collaboration by understanding and leveraging a common purpose, trust, clear roles, open communication, diversity, and tasks and responsibilities
3. Creating a Team Charter	Designing and following a team charter that includes the team's purpose, key customers, key result areas, and guiding values
4. Team Communication Basics	Learning and using listening guidelines and basic communication guidelines
5. Managing Team Conflict	Recognizing different conflict situations, such as internal conflict, conflict with one other team member, conflict with the entire team, team conflict with one member, conflict among several team members, conflict between teams, and conflict with one person outside the team
6. Making Group Decisions	Learning different decision making methods, such as autocratic, democratic, participative, consensus, and unanimous Participating in the "Avalanche on the Ruth" decision-making scenario
7. Facilitating Team Interactions	Creating operating guidelines and using steps for facilitating a meeting
8. Giving and Receiving Feedback	Introducing team members to their shared roles as coaches who give and receive feedback to improve team performance Preparing a set of feedback to deliver to a teammate, delivering feedback
9. Goal Setting and Measuring Results	Organizing benchmarking information Determining the types of information the team needs to measure current performance
10. Managing Team Performance	Identifying key stakeholders, their expectations, and tips and tools for addressing stakeholder concerns Identifying the team's core purpose Analyzing key result areas and potential performance problems
11. Understanding Principles and Boundaries	Diagnosing existing team values Removing unnecessary policies Identifying boundary conditions for team responsibilities and duties
12. Team Problem Solving	Completing start, stop, continue exercise Creating and using mind maps, pareto charts, cause-and-effect diagrams, force field analyses, flow charts, weighted criteria worksheet, and action planning
13. Team Member Roles and Responsibilities	Completing a work analysis, team member role descriptions, team meeting roles, and cross-training matrix
14. Selecting Team Members	Delineating human resources and team duties Developing selection criteria, position description, and candidate evaluation and integrating new team members
15. Working With Your Supply Chain	Completing customer profiling, raising awareness of customers, knowing team capabilities, getting customer feedback, completing same for suppliers

Results

Descriptive Statistics

Table 3 displays the means, standard deviations, reliability coefficients, and zero-order correlations for the study variables. As Table 3 shows, teams' average training proficiency had no clear relation with customer satisfaction ($r = -.05$, *ns*).

Hypothesis Tests

To test Hypotheses 1–3, we used moderated regression (see Table 4) after centering the variables of interest. In Step 1, we entered all control variables (i.e., team size, number of training modules completed, task interdependence, and electronic communication dependence). In Step 2, we entered the main effects of average training proficiency scores, trust, technology support, and team leader tenure. The relation between average training proficiency and customer satisfaction in the regression model ($\beta = .11$, *ns*) was consistent with the correlational results, and the overall squared multiple correlation value for the model (.22) was not significant.

In Step 3, we entered interaction terms for teams' average training proficiency and team trust, technology support, team leader tenure, and electronic communication dependence (as a control). As one can see in Table 4, adding the interaction terms resulted in a significant increase in squared multiple correlation ($\Delta R^2 = .36$), $F(4, 23) = 2.63$, $p < .01$, indicating moderating effects. The interaction terms for average training proficiency and team trust ($\beta = .44$, $p < .01$, $\Delta R^2 = .16$), technology support ($\beta = .43$, $p < .05$, $\Delta R^2 = .07$), and team leader tenure ($\beta = .61$, $p < .01$, $\Delta R^2 = .09$) were all significant. For the unique variance explained by each interaction term, Table 4 also shows the change in squared multiple correlation for each interaction entered separately before (Column 4) and after (Column 5) all remaining interactions were entered.. We plotted the significant interactions in Figures 1, 2, and 3 using Aiken and West's (1991) procedure. As expected, the relation between average training proficiency and customer satisfaction was more strongly positive when team trust and technology support were high, rather than low (supporting Hypotheses 1 and 2, respectively), and when team leaders had longer, rather than shorter, team leader tenure (supporting Hypothesis 3). The inter-

Table 3
Means, Standard Deviations, Reliabilities, and Correlations for Study Variables

Variable	*M*	*SD*	*n*	1	2	3	4	5	6	7	8	9
1. Team size	9.38	2.87	40	—								
2. No. training modules completed	10.85	2.27	40	−.28	—							
3. Task interdependence	5.40	1.22	36	.17	−.05	(.69)						
4. Electronic communication dependence (%)	68.97	16.94	40	.03	−.09	.18	—					
5. Average training proficiency (%)	86.21	3.17	40	−.13	.02	−.12	−.02	—				
6. Team trust	5.61	0.53	40	−.22	−.07	.11	−.17	−.08	(.93)			
7. Technology support	4.89	1.53	36	.01	.00	.12	.13	.44**	.17	(.92)		
8. Team leader tenure (months)	25.06	28.81	36	−.14	−.03	−.04	.04	−.13	−.01	−.45**	—	
9. Customer satisfaction (%)	85.74	7.84	40	−.01	.02	.06	.24	−.05	.24	−.01	.29	—

Note. Reliabilities are shown in the diagonal where applicable.
** $p < .01$.

action of average training proficiency and electronic communication dependence (a control) was not significant.

Discussion

As Salas and Cannon-Bowers (2001) stated, "training evaluation is labor intensive, costly, political, and many times the bearer of bad news" (p. 487). One possible explanation for the disappointing results in the area of team training transfer is that researchers and practitioners have overlooked key moderating variables that influence whether teams (and, as a result, customers) actually benefit from training. Three variables—team trust, technology support, and team leader tenure—had significant effects on whether technology-based team training provided to members of GDTs was associated with enhanced customer satisfaction.

Theoretical Implications

We have identified underlying theoretical rationales for why knowledge gained in a technology-based teamwork training program may or may not transfer to the actual job. First, our finding that the relation between average training proficiency and customer satisfaction was more strongly positive when teams were higher, rather than lower, in team trust supports previous theory and research on the importance of trust in GDTs (Gibson & Manuel, 2003; Jarvenpaa et al., 1998; Jarvenpaa & Leidner, 1999; O'Hara-Devereaux & Johansen, 1994). Although other researchers have explored GDT trust empirically, our study is the first to examine its moderating role in the relation between GDTs' average training proficiency and performance. Collective trust was very important for the transfer of teamwork skills in GDTs, as lack

Table 4
Results of Moderated Regression Analysis Predicting Customer Satisfaction

Predictor	Step 1	Step 2	Step 3	ΔR^2 when entered first	ΔR^2 when entered last
Team size	−.06	.09	.29		
No. training modules completed	.09	.15	.34		
Task interdependence	.03	.00	.29		
Electronic communication dependence	.24	.30	.16		
Average training proficiency		.11	.21		
Team trust		.27	.20		
Technology support		−.01	.09		
Team leader tenure		.30	.42*		
Team Trust × Average Training Proficiency			.44**	.16*	.14*
Technology Support × Average Training Proficiency			.43*	.08*	.07*
Team Leader Tenure × Average Training Proficiency			.61**	.14*	.06*
Electronic Dependence × Average Training Proficiency			−.35	.04	.01
ΔR^2	.07	.15	.36**		
ΔF	0.57	1.28	4.93		
df	4, 31	4, 27	4, 23		
Total R^2	.07	.22	.58**		
F	0.57	0.93	2.63		
df	4, 31	8, 27	12, 23		

Note. Tabled values are standardized regression weights unless otherwise labeled.
* $p < .05$. ** $p < .01$, one-tailed.

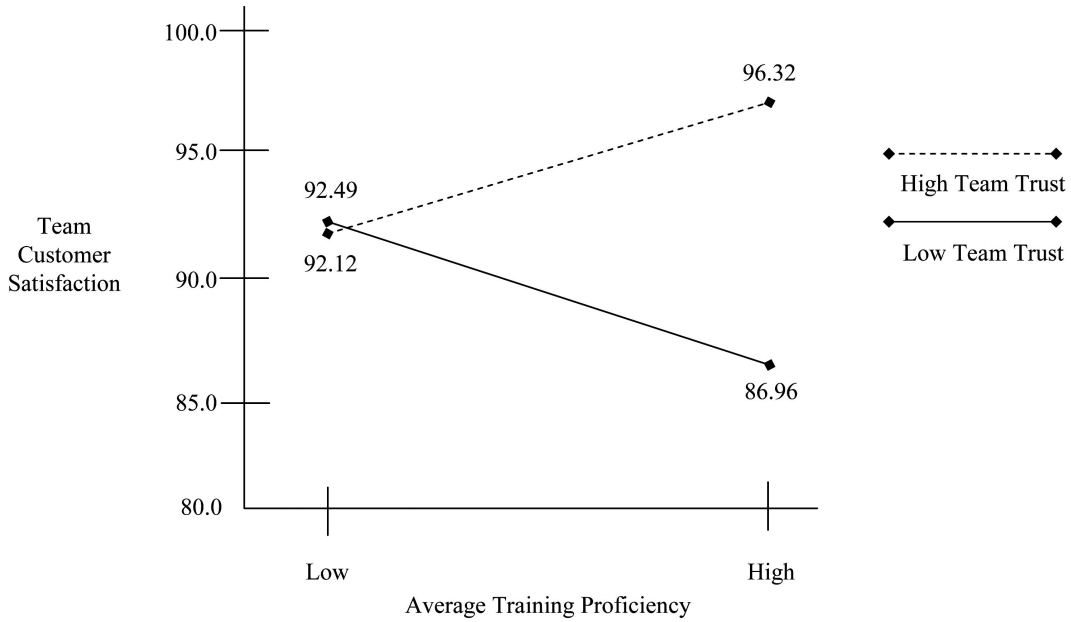

Figure 1. Plot of interaction effect of team trust on the average training proficiency–customer satisfaction relation.

of trust weakened the association between average training proficiency and customer satisfaction. It is interesting to note that the lowest level of customer satisfaction occurred when teams had low levels of trust but high average training proficiency (see Figure 1). In other words, increases in training knowledge were negatively associated with customer satisfaction for low-trust teams. Perhaps team members who had mastered the teamwork skills they needed were unable or unwilling to apply them in a team environment characterized by low trust (Jones & George, 1998).

Second, our finding that average training proficiency was positively associated with customer satisfaction when teams had high, rather than low, technology support reinforces the theoretical importance of providing GDT members with adequate and appropriate technology (Bikson et al., 1999; Griffith et al., 2003; King & Majchrzak, 2003; Rioppelle et al., 2003) and supports empirical investigations of technology importance in GDTs (Majchrzak, Rice, Malhotra, & King, 2000). Our finding confirms a link among resources provided at the organizational level, GDT enabling conditions, and GDT performance—relations that have been proposed in comprehensive models of GDT performance (e.g., Cohen & Gibson, 2003; Driskell et al., 2003) but not yet tested. Teams that had both high average training proficiency and high technology support had more satisfied customers than teams with high average training proficiency and low technology support. Similar to trust, the lowest level of customer satisfaction occurred when teams scored high on postmodule training tests but had low levels of technology support. Customer satisfaction was based on responsiveness, and teams with limited technological support might have

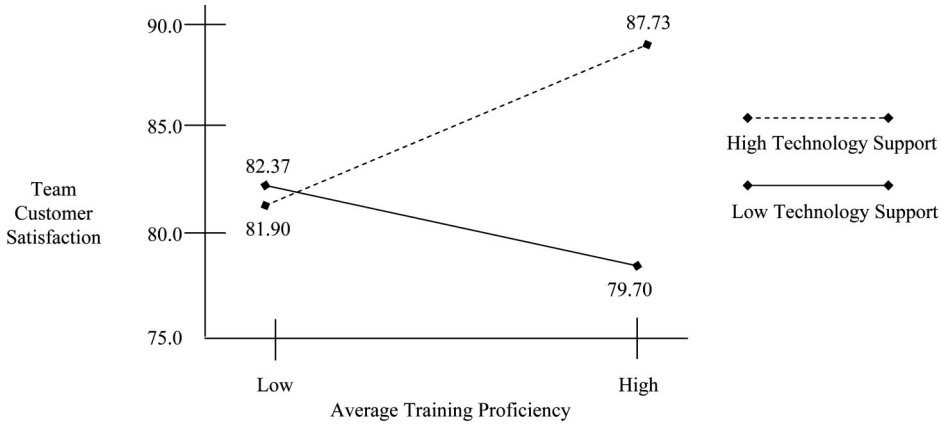

Figure 2. Plot of interaction effect of technology support on the average training proficiency–customer satisfaction relation.

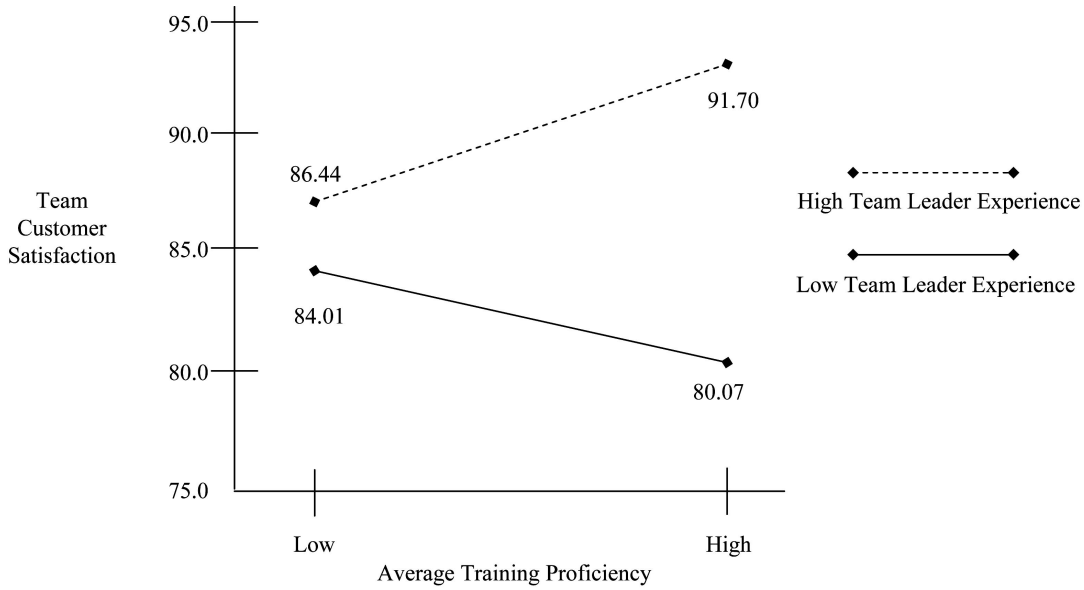

Figure 3. Plot of interaction effect of team leader experience on the average training proficiency–customer satisfaction relation.

been unable to use teamwork to coordinate their efforts, solve problems, and respond to customers in a timely manner.

Third, similar to the findings for trust and technology support, we found that average training proficiency was positively associated with customer satisfaction in teams with longer team leader tenure. Our findings extend previous research on the importance of leadership experience (Fiedler & Garcia, 1987; Sternberg, 2003; Sternberg, Wagner, Williams, & Horvath, 1995) by supporting the contention that a team leader's experience with his or her specific team can influence the relation between average training proficiency and performance. Researchers have argued that relationship building is an important quality of team leadership (Bass, 1990). Compared with longer tenured leaders, shorter tenured team leaders have not had as many opportunities to build relationships with team members, which may be worse in GDTs in which leaders rarely see team members. Building on research linking experience, knowledge development, and leadership, we conjecture that greater experience likely provided team leaders with practical intelligence to help teams use new teamwork skills to solve customer satisfaction problems.

In summary, our study makes several contributions to the literature. First, contrary to most previous investigations of training transfer, we moved beyond the individual level to assess contextual elements that influenced training transfer at the team level of analysis (Salas et al., 1992). In addition, we have extended previous research by simultaneously assessing factors from both the team characteristic and the work environment categories of training inputs, whereas most previous research examined these factors independently (Baldwin & Ford, 1988; Ford & Weissbein, 1997). Second, we have extended previous research by examining more proximal contextual factors that were specifically related to the nature of the content of training (i.e., teamwork), in contrast to previous research that focused on more general, distal climate factors (Kozlowski & Salas, 1997). Thus, our findings should be particularly important for those organizations interested in enhancing customer satisfaction through teamwork training. Third, we examined teamwork training transfer in a GDT context, a relatively new and understudied form of collaboration that is growing in popularity (Gibson & Cohen, 2003; Townsend et al., 1998). Moreover, we examined a technology-based teamwork training program that used self-guided, CD-ROM-based materials in a distributed team setting. Such training tools are relatively new, and more research is needed to determine the efficacy of technology-based, computer-assisted training for teams that are geographically dispersed (Salas & Canon-Bowers, 2001). Finally, we used actual team performance to assess the moderating effects of team and work environment characteristics on transfer. The bulk of previous research relied on trainee reactions (Baldwin & Ford, 1988; Salas & Cannon-Bowers, 2001; Tannenbaum & Yukl, 1992). To our knowledge, no studies have used customer satisfaction as an indicator of training transfer at the team level.

Managerial Implications

On the basis of our findings, GDT leaders should ensure that there are high levels of trust (see Gibson & Manuel, 2003) and technology support (see Bikson et al., 1999) prior to the administration of significant distributed teamwork training. Although building trust is difficult for any type of team (Jones & George, 1998), a geographically dispersed work environment magnifies and exacerbates issues of trust that confront teams (Kirkman et al., 2002). As one can see in Figure 1, even the best trained teams may not be able to fully transfer their newly acquired teamwork skills in ways that improve customer satisfaction when trust is low. Managers should also provide GDTs with both the technology tools needed to communicate and carry out work and the support needed to effectively use the tools. Beyond providing appropriate technology tools, managers should assist GDT members in know-

ing when to use what technology (Rioppelle et al., 2003). Finally, regarding team leadership experience, organizations might sequence the onset of teamwork training for GDTs, starting with teams that have leaders with considerable experience and longevity with their teams. In addition, organizations might encourage leaders to remain with their teams longer. Organizations should attempt to document the behaviors of leaders who have considerable experience with their GDTs and identify those behaviors that are most helpful in facilitating transfer of training. These best practices—or lessons of experience—could then be communicated to leaders who are relatively new to their teams.

Limitations and Future Research

One limitation is the absence of a control group that did not undergo training. However, our study was focused on the factors that moderate average training proficiency. Thus, withholding training to create control groups would not have advanced the objective of our research (i.e., one cannot test moderators on teams that did not receive training). A second limitation is the relatively small set of moderators selected. We admit that there are other plausible choices for both team characteristics (e.g., potency, cohesion, empowerment) and the work environment (e.g., reward structure). Future researchers should continue to examine other moderators of the average team training proficiency–performance relation. Finally, we did not examine which technology types are best for communicating about teamwork training. In the future, researchers should attempt to determine which communication tools (and under what conditions) enhance teamwork training transfer in GDTs. Given the substantial investments often made in training programs and the challenges posed by GDTs, our findings and these extensions of our research are critical for organizations interested in enhancing team effectiveness.

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Appendix

Survey Items Used in the Study

Team Trust (Adapted From Jarvenpaa & Leidner, 1999)

1. My team members have a high degree of trust between each other.
2. My team members believe that others on the team will follow through on their commitments.
3. My team members always do what they say they will do.
4. My team members trust each other to contribute worthwhile ideas.

Technology Support (Study-Specific Measure)

1. The team members have adequate technology to work together effectively.
2. The team's performance would greatly improve if members had better technology (reverse scored).
3. The team members are sufficiently trained to use the technology to its full potential.

Task Interdependence (Campion et al., 1993)

1. This team cannot accomplish its tasks without information or materials from other members of the team.
2. Members of this team depend on each other for information or materials needed to perform their tasks.
3. Within this team, jobs performed by team members are all related to one another.

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