

Adaptation of Teams in Response to Unforeseen Change: Effects of Goal Difficulty and Team Composition in Terms of Cognitive Ability and Goal Orientation

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Halfway through a 3-hour experiment in which 64 3-person teams needed to make a series of decisions, a communications channel began to deteriorate, and teams needed to adapt their system of roles in order to perform effectively. Consistent with previous research, team composition with respect to members' cognitive ability was positively associated with adaptation. Adaptation was also influenced by interactions of team goal difficulty and team composition with respect to team members' goal orientation. Teams with difficult goals and staffed with high-performance orientation members were especially unlikely to adapt. Teams with difficult goals and staffed with high-learning orientation members were especially likely to adapt. Supplemental analyses provided insight into the observed effects in that the difficulty of team goals and members' goal orientation predicted interpersonal, transition, and action processes, all of which predicted team adaptation.

Keywords: team, adaptation, goal orientation, goal setting, cognitive ability

One way in which knowledge about teams is deficient is that there is a lack of understanding of how to promote team effectiveness in circumstances in which the team has to continue to work despite some unforeseen change that makes the team's routine network of workflow transactions inappropriate and in which the unforeseen change creates a situation for which the team has had limited experience or training (Kozlowski, Gully, Nason, & Smith, 1999; Waller, 1999). Although not all types of teams have to "adapt on the fly" in response to nonprogrammed change in this manner, the ability to do so is critically important for teams that must integrate information in order to make decisions over a defined time period to complete a unit of work. The effectiveness of production teams that are involved in long-linked or continuous flow processes, surgical teams, flight crews, and command and control teams, often depends on their ability to adapt in the course of performing their tasks because they do not typically have the ability to stop what they are doing to plan a response to an equipment malfunction or other unforeseen change. Behling, Coady, and Hopple (1967) noted this shortcoming in researchers' understanding of this type of team adaptation over 30 years ago;

yet, research on this topic has only recently begun to appear in the literature (e.g., Arrow, 1997; Hutchins, 1996; Kozlowski et al., 1999; LePine, 2003; Marks, Zaccaro, & Mathieu, 2000; Waller, 1999). Thus, a general purpose of this study was to increase understanding of the factors that influence the ability of a team to function when confronted with an unexpected change that makes the team's established routine inappropriate.

A more specific purpose of the present research was to increase understanding of the effects of team goals on team functioning and effectiveness in circumstances in which the team is confronted with an unexpected change in the task context. Effects of goal setting have been studied for decades, and this research clearly indicates that specific and difficult performance goals are beneficial with respect to promoting performance of both individuals and teams. At the same time, however, there is theoretical and empirical evidence suggesting that difficult goals may be less effective, or even detrimental, in novel or complex tasks (Earley, Connolly, & Ekegren, 1989; Kanfer & Ackerman, 1989; Latham & Locke, 1991; Wood, Bandura, & Bailey, 1990). Although this research has primarily focused on the relationship between individual-level goals and the results of individual-level performance (i.e., outcomes), it is possible that when there is unforeseen change that creates a novel task context, difficult goals may hinder a team's ability to adapt or modify its configuration of roles. Given the research demonstrating that effective adaptation of a team's role structure in light of unforeseen change is crucial to a team's ability to perform effectively after the change (Hutchins, 1996; LePine, 2003), this gap in knowledge may be very important to address.

Beyond the theoretical insight obtained by studying the relationship between the difficulty of team goals and adaptation in response to a changing task context, there are practical implications as well. Team-based organizations exist in competitive environments characterized by change, and this places a premium on competence with respect to changing, sometimes radically, *what* is

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done as well as *how* it is done (Howard, 1995). As a consequence, managers may question the usefulness of management practices and production systems that include goal setting, even in stable task contexts in which difficult goals may be good, given that without warning, changes may occur that make difficult goals bad (O'Reilly & Pfeffer, 2000). The study reported in the present article addressed this issue by assessing the extent to which staffing teams in terms of certain individual differences (cognitive ability and goal orientation) buffer or offset the potential downside of using goal-based practices in changing task contexts. The present study also considered team processes in a set of supplemental analyses aimed at identifying potential mechanisms through which the interaction of team goals and team composition influence team adaptation. Consistent with the notion that adaptation is a developmental process (Kozlowski et al., 1999), this supplemental analysis was guided by a theory of team processes that explicitly considers process effects at different points in time (Marks, Mathieu, & Zaccaro, 2001).

Adaptation

Most definitions of adaptation refer to the manner or extent to which a theoretical unit (i.e., person, group, or organization) achieves correspondence between the unit's behavior and a set of novel demands faced by the unit (e.g., Chan, 2000). However, there are distinctions among adaptation concepts with respect to the nature of how the correspondence is achieved. Pulakos and her colleagues' research (Pulakos, Arad, Donovan, & Plamondon, 2000; Pulakos, Schmitt, Dorsey, Arad, Hedge, & Borman, 2002) perhaps best illustrates the breadth of the adaptation concept with respect to content. They conceptualize adaptation as an aspect of individual-level job performance consisting of eight distinct behavioral dimensions. Of these eight dimensions, "dealing with uncertain and unpredictable work situations" seems most similar to the type of adaptation required of team members in the present research. Specifically, this dimension refers to behaviors such as "readily and easily changing gears in response to unpredictable or unexpected events and circumstances; effectively adjusting plans, goals, actions, or priorities to deal with changing situations; and refusing to be paralyzed by uncertainty or ambiguity" (Pulakos et al., 2000, p. 617). Of course, other dimensions of individual-level adaptive performance they identified may be relevant as well. For example, handling work stress (i.e., managing frustration well by directing effort toward constructive solutions rather than blaming others); solving problems creatively (i.e., thinking outside the given set of parameters to see whether there is a more effective approach); learning work tasks, technologies, and procedures (i.e., adjusting to new work processes and procedures); and demonstrating interpersonal adaptability (i.e., listening to and considering others' viewpoints and opinions and altering one's opinion when it is appropriate to do so) are behaviors that team members need to enact in order for their teams to adapt to unforeseen change.

Whereas much of the previous work on adaptation has focused exclusively on the individual as the unit of analysis (Chan, 2000; LePine, Colquitt, & Erez, 2000; Pulakos et al., 2000, 2002; Smith, Ford, & Kozlowski, 1997), other research has considered adaptation of teams. Kozlowski et al. (1999) offered a normative theory describing how the process of team development builds performance capabilities associated with adaptability. Their theory sug-

gests that, over time, knowledge and skill compile at increasingly higher levels (individual, dyad, and team) and that team adaptation depends on the ability of a team to use this "compilation" in selecting or creating, evaluating, and modifying workflow transactions among team members—who may be thought of as nodes in a network—to meet the demands of a new situation. The present research is concerned with adaptation in response to an unforeseen change that creates problems for which the team has had limited experience or training, and thus the focus here is on adaptation that depends a great deal on *network invention*—or the extent to which a team is able to modify its configuration of roles into a new configuration of roles using knowledge acquired through interaction in the course of task execution as well as through more explicit exploration of transaction alternatives.

In one recent empirical study, LePine (2003) found that this form of adaptation, or in his words "role structure adaptation," was promoted in teams with members possessing high cognitive ability, achievement striving, openness to experience, and low dependency. However, this research did not consider the temporal aspect of adaptation, and this is unfortunate given that adaptation is the result of a learning or development process that occurs over time (Kozlowski et al., 1999). Accordingly, the present research extends this previous study not only by considering a different set of predictors of role structure adaptation (i.e., goal difficulty and goal orientation) but also by measuring and modeling observations of team activity over time. Another way in which the present research extends the previous research is that whereas the contextual change in the previous study occurred abruptly, a more gradual deterioration of conditions is considered in the present study. Thus, the design of this study allows for more opportunity for knowledge and skill compilation to occur prior to the point at which an adaptation should be implemented.

Goal Difficulty

A great deal of research supports the conclusion that given adequate commitment, specific and difficult goals lead to higher individual-level performance than easy or vague goals. Goal specificity is important because vague goals are compatible with too many outcomes and thus lead to ambiguity concerning what constitutes effective performance (Latham & Locke, 1991). As Klein (1989) suggests, "[v]ague goals make poor referent standards because there are many situations in which no discrepancy would be indicated and, therefore, there would be no need for corrective action (Campion & Lord, 1982)" (p. 154). Goal difficulty is important because individuals adjust their effort to the difficulty of the task (Latham & Locke, 1991). The positive effects of goal setting on performance, however, are more often observed in tasks that are well learned (Kanfer & Ackerman, 1989) and low in complexity (Wood & Locke, 1990) rather than in tasks that are novel or higher in complexity. One rationale for this moderating effect of task complexity/novelty is that difficult goals cause more attention to be focused on performance outcomes and therefore hinder the ability or tendency of individuals to develop plans or strategies to cope with the complexity/novelty (e.g., Earley et al., 1989; Wood & Locke, 1990).

Although most research on goal setting is focused on individual-level relationships, there is also research that has examined group-level relationships (e.g., O'Leary-Kelly, Martocchio, & Frink,

1994; Pritchard, Jones, Roth, Stuebing, & Ekeberg, 1988; Weingart, 1992; Weingart & Weldon, 1991; Weldon, Jehn, & Pradhan, 1991; Weldon & Weingart, 1988). Conceptually, group-level goals research is more complex than individual-level goals research because, as Zander (1981) noted, there are different levels of goals within a group (e.g., the goal for the group, each member's own goal as a group member). However, the nature and level of team members' goals and subsequent behavior (e.g., being responsive to requests from team members, making useful recommendations to the leader) may manifest from an acceptance of higher order team-level goals (e.g., a successful surgery; Zander, 1971). In one study, for example, Weingart and Weldon (1991) found that individuals were more likely to set goals for themselves when their group was assigned a goal. Also, when groups were assigned a difficult goal, members developed more efficient strategies for their role than did members in groups assigned an easy goal, and this translated into improved group performance.

DeShon, Kozlowski, Schmidt, Milner, and Wiechmann (2004) go even further in describing the relationship between individual and team goals in that they offer and find support for a multilevel theory that suggests that goals function similarly at both the individual and team levels. Specifically, team-level goals were shown to serve the same function in the team-regulatory process as do individual-level goals in the self-regulatory process. Their theory suggests that, just as individual-level feedback influences individual goals, team-level feedback influences team goals. Moreover, just as individual goals influence individual effort and strategy, team goals influence team effort and strategy. Research supporting the homology of individual and team regulation is relevant to the present research because it supports the idea that difficult team goals may detract from adaptation to changing task contexts for reasons similar to why difficult individual goals detract from individuals' ability to perform in novel circumstances. Specifically, in changing circumstances, difficult team goals may be problematic to teams because they cause more attention to be focused on performance outcomes, and, therefore, they may hinder the development of strategies to deal with the change. In the words of Kozlowski et al. (1999), difficult team goals may hinder the "short terms cycle of 'on-line' selection or creation, evaluation, and modification of the network to fit the task" (p. 271). I suggest next that composing teams in terms of certain individual characteristics may play an important role in influencing the nature of the effects of the difficulty of team goals on the adaptation of teams to a changing task context.

Team Composition With Respect to Members' General Cognitive Ability

General cognitive ability is a characteristic of individuals that reflects the capacity to process information and learn (Hunter, 1986; Kanfer & Ackerman, 1989). Cognitive ability relates positively to performance in most jobs (Hunter, 1986; Ree, Earles, & Teachout, 1994); however, the cognitive ability–performance relationship tends to be stronger in jobs with novel and complex tasks rather than in jobs that are routine and simple (Hartigan & Wigdor, 1989; Hunter & Hunter, 1984). Consistent with these findings, some researchers have demonstrated that individuals' general cognitive ability is positively related to their performance on tasks for which they have to adapt to unforeseen change in the

task or task context (LePine et al., 2000). This effect is attributed to the notion that information-processing demands increase after an unexpected change because of the need to unlearn and relearn how to do the task in light of the new situation.

Although the great majority of studies on effects of general cognitive ability have focused on individual-level relationships, scholars have also examined the relationship between the aggregated level of general cognitive ability among team members and team-level performance. In this research, the perspective most often adopted is that the attributes of the individuals comprising a team, in the aggregate, can be thought of as resources of the team (e.g., LePine, Hollenbeck, Ilgen, & Hedlund, 1997; Taggar, Hackett, & Saha, 1999), which promote team effectiveness (Devine & Philips, 2001; Heslin, 1964). An obvious explanation for this positive relationship is that team members who have high cognitive ability tend to be more effective in their individual roles, and, all else being equal, teams with members who possess more individual task competence are likely to be more effective (Hackman, 1987; Steiner, 1972). In addition, however, members with higher cognitive ability also learn more from their experiences working with others. Ultimately, this knowledge compiles to the team level and facilitates the development of network knowledge that is needed in order to invent new patterns of behavior when required. Consistent with this line of reasoning and the results of prior research, I predict the following:

Hypothesis 1: After an unexpected change in the task, there will be a positive relationship between the level of team members' cognitive ability and role structure adaptation.

The level of team members' cognitive ability should also moderate the relationship between team goal difficulty and role structure adaptation. As noted earlier, difficult team goals may be problematic in changing contexts because they hinder the ability of teams to systematically consider and test strategies intended to cope with the change. However, this may be less of a problem in teams with members who possess high cognitive ability. These teams include individuals who process information more quickly, and therefore these teams should be more likely to possess the level of distributed information-processing capacity necessary to systematically cycle through the process of creating, evaluating, and modifying potential network alternatives when some of their attention is focused on goal-relevant performance feedback.

Hypothesis 2: After an unexpected change in the task, the relationship between the difficulty of team goals and role structure adaptation will be moderated by the overall level of cognitive ability of the team such that the relationship will be more positive for teams comprising high-cognitive ability members.

Team Composition With Respect to Members' Goal Orientation

Goal orientation reflects the nature of the desires and reactions that individuals have in a performance or learning situation. A *learning orientation* reflects the desire to understand something novel or to increase competence in a task, and a *performance orientation* reflects the desire to gain favorable judgments of

performance or avoid negative judgments of competence (Button, Mathieu, & Zajac, 1996). Of direct relevance to the present research, individuals with a learning orientation tend to engage in a pattern of behavior that makes them adaptive. These individuals tend to feel challenged and continue to strive despite the negative feedback that is likely to accompany difficult or novel tasks. In fact, those with a learning orientation believe that negative feedback is useful in that it provides information regarding how to solve problems (Elliott & Dweck, 1988). Individuals with a performance orientation, however, tend to engage in a pattern of behavior that makes them maladaptive. These individuals tend to experience negative affect in the face of obstacles created by a difficult or novel task and may, in fact, seek to avoid or withdraw from the situation entirely. Recent research suggests that the adaptive or maladaptive nature of performance and learning orientation may depend somewhat on the nature of the criterion as well as on other individual differences (Bell & Kozlowski, 2002).

Although the literature has focused on the goal orientations of individuals, there are reasons to expect that the aggregated levels of learning and performance orientation among team members may be relevant to the adaptation of teams. A team composed of members who possess high-learning orientation may be adaptive because its members are likely to be persistent in exploring alternative ways of approaching the task in light of the new situation. This type of activity should facilitate the knowledge compilation process and also, ultimately, the likelihood of network invention and adaptation. To some extent, this expectation was supported indirectly in a recent study in which team-level learning orientation was positively associated with learning and performance of management teams (Bunderson & Sutcliffe, 2003). However, this previous study conceptualized team-level learning orientation as a collective construct (i.e., teams have a performance orientation) rather than as an aggregate construct, as in the present research (i.e., teams can be characterized with respect to the level of members' learning orientation). A team composed of members who possess high-performance orientation may be maladaptive because, in the face of unforeseen change and subsequent performance decrements, members will tend to withdraw from instead of invest in the effort it takes to acquire the type of knowledge necessary for adaptation to occur. In essence, withdrawal of effort among members should short-circuit the knowledge compilation process described by Kozlowski et al. (1999) and thus should also reduce the likelihood of network invention and adaptation.

Hypothesis 3: After an unexpected change in the task, there will be a positive relationship between the level of team members' learning orientation and role structure adaptation.

Hypothesis 4: After an unexpected change in the task, there will be a negative relationship between the level of team members' performance orientation and role structure adaptation.

Team composition with respect to goal orientation may also influence the potential negative effects of team goal difficulty in changing task contexts. As noted earlier, team goals appear to function similarly across individual and team levels of analysis (DeShon et al., 2004), and therefore a problem with difficult team goals in a changing task context is that the goal causes more

attention to be focused on goal-relevant performance and less attention to be focused on developing and experimenting with potential courses of action to take that may seem more distal to the goal. This tendency, however, may not be present in teams comprising members who possess high levels of learning orientation. Members with high-learning orientation should tend to view an unforeseen change as a challenge to overcome and an opportunity to increase task competence (Diener & Dweck, 1978). In fact, these types of positive feelings and beliefs may be more likely in teams with difficult goals than in teams with easy goals given that performance decrements tend to be larger with difficult goals, and this should increase the salience of the change (and challenge) to the members. In this situation, those with high-learning orientation will communicate with one another regarding the nature of the problem and potential solutions, and, over time, this knowledge should compile to the team level and promote network invention and adaptation. For teams comprising members who possess high levels of performance orientation, however, difficult goals are likely to be especially problematic with respect to adaptation. Difficult team goals will increase the salience of performance decrements that accompany unexpected change. To those with a high-performance orientation, salient performance decrements will likely be highly threatening, thus increasing the likelihood of negative affective reactions and task withdrawal. Individuals in such teams should be especially unlikely to communicate with one another regarding potential solutions, and, thus, the team should be especially unlikely to compile the type of knowledge necessary for adaptation to occur.

Hypothesis 5: After an unexpected change in the task, the relationship between the difficulty of team goals and role structure adaptation will be moderated by the overall level of learning orientation on the team such that the relationship will be less negative for teams comprising high-learning orientation members.

Hypothesis 6: After an unexpected change in the task, the relationship between the difficulty of team goals and role structure adaptation will be moderated by the overall level of performance orientation on the team such that the relationship will be more negative for teams comprising high-performance orientation members.

Method

Participants

Participants included 192 college juniors and seniors recruited from a large multisection undergraduate management course. The mean age for these participants was about 21 years, and approximately half were men. Participants who completed the study received course participation credit. Participants were configured into 64 three-person teams. Participants could win money on the basis of their team's performance, and they were informed of this possibility during their training. The top-performing team in each condition received a reward of \$60. Second- and third-place teams in each condition received rewards of \$45 and \$30, respectively. Although participants in top-performing teams did not receive their rewards until the end of the semester, participants often made comments to one another (and also to the experimenters) that reflected a strong desire to earn one of the rewards. Thus, participants seemed motivated to perform well.

Procedure

The study took place in a laboratory, using a 3-hour computerized decision-making simulation called Team Interactive Decision Exercise for Teams Incorporating Distributed Expertise (TIDE²; see Hollenbeck et al., 1995, for a more complete description). The TIDE² software requires participants to make decisions about a series of problems on the basis of the values of several attributes. As in previous research using TIDE², participants were seated at networked computers and were responsible for communicating over this network in order to make decisions about a series of aircraft within an area of responsibility. There were three jobs in the simulation—Alpha, Bravo, and Charlie—and each had a unique role. Alpha needed to make recommendations on the basis of the number of unidentified aircraft, range of the unidentified aircraft, and position of the unidentified aircraft relative to a commercial air corridor. Bravo was trained how to make recommendations on the basis of the unidentified aircraft's heading-crossing angle, altitude, and speed. Finally, Charlie was trained how to make recommendations on the basis of the value of the electronic security measure (an electronic code, scored to indicate confidence that aircraft is friendly), radar cross-section (the size of the aircraft as indicated by the radar signal), and rate change altitude ([RCA] the rate of ascent or descent). Each participant was trained to make recommendations using knowledge of all three attributes because a value indicating "nonthreatening" for any attribute within an area of specialization made the correct role recommendation "ignore." Although each role or area of specialization consisted of interpreting three distinct cue values, no member was able to directly access all the information needed to make a recommendation. Thus, the members of the teams were interdependent. Alpha needed to transmit "speed" to Bravo, Bravo needed to transmit "RCA" to Charlie, and Charlie needed to transmit "corridor status" to Alpha. In addition to having an area of specialization, Alpha was also responsible for making the final team decision. Alpha was taught that the final correct decision for each aircraft should be made after considering his or her own role-based information as well as the recommendations of Bravo and Charlie. Teams assessed the same series of aircraft in terms of their level of threat. Recommendations and decisions were made using a seven-point continuum ranging from 1 (*ignore*; lowest level of threat) to 7 (*defend*; highest level of threat). Participants received feedback indicating the accuracy of their decision as well as the team's average performance across the nontraining trials.

After arriving at the laboratory, participants were randomly assigned to teams and roles. Training occurred during the first trial, after which there were four additional training trials for practice. Training consisted of instruction regarding the mechanics involved in gathering and sharing information. These mechanics included (a) *measuring* attribute values, (b) *querying* others for attribute values, (c) directly *transmitting* attribute values to others (only permitted on values that could be measured by the station), and (d) *communicating* via sentence-long free-form text messages (not permitted between Bravo and Charlie). The training also involved instruction on individuals' area of specialization. Participants were encouraged to practice using the equipment and communicating with each other. A research assistant answered questions and clarified misunderstandings. In order to ensure that teams established the same routine prior to the change manipulation, the training also included instruction on how to exchange information most efficiently (i.e., directly transmitting information to the person needing it without having to be asked). After the fifth trial, the simulation was paused and any final questions were answered. Similar to the LePine (2003) study, the unforeseen change was the failure of the transmit mechanism between Bravo and Charlie. Bravo was able to select "Transmit RCA" from the pull-down menu; however, the value for RCA did not reach Charlie. In contrast to this previous study, the failure of the communications link did not occur abruptly. Instead, the failure was gradual, beginning on Trial 44 and occurring with increasing frequency until it completely failed after Trial 63. The gradual-change treatment was used in the present study because change often occurs gradually rather than

abruptly. Moreover, the gradual-change treatment allowed insight into what occurred during the change when there was uncertainty rather than just after the change when the nature of the problem should have been clearer. In essence, this feature of the study design provided more opportunity to observe differences among teams in that the uncertainty provided more opportunity for communication about the nature of the problem. Because the situation continued to deteriorate and never fixed itself, it is easy to see after the fact that teams should have developed and used a new role structure as soon as possible after the initial disruption. However, teams would have been better off not changing their role structure if the disruption was only temporary and participants had no reason to believe otherwise. Thus, because there were 83 decision trials and because clarity with respect to an appropriate role structure was not possible for participants until the disruption stabilized, only the final 20 decision trials were considered as having the potential for adaptation.

Variables

Goal difficulty. Easy and difficult goal levels were set at approximately one standard deviation below and above the mean performance level (prior to the disruption) of teams ($N = 20$) in a pilot study. During the primary study, participants received the goal manipulation after the first training trial. Participants were told that "Even though you all have different roles, you should work as a team to achieve a goal of at least (insert easy or difficult goal level) as an average score." To ensure that the manipulation would be administered effectively, the statement was repeated following the training (i.e., just prior to the start of the trials that would "count"). Following the experiment, participants answered two questions about their team's goal as a manipulation check ("How difficult was your assigned goal?" "How challenging was your assigned goal?") using a 5-point scale ranging from 1 (*very easy*) to 5 (*very difficult*) and from 1 (*very unchallenging*) to 5 (*very challenging*). Because the manipulation focused on the difficulty of team goals, I assessed the manipulation at the team level. Members of teams agreed with one another about the scores they provided (intraclass correlation 1 [ICC1] = .36, $p < .05$). The measure was reliable from both an internal consistency (mean item alpha across members = .89) and interrater perspective (ICC2 = .62). Finally, there was a positive relationship between the goal difficulty manipulation and the team-level ratings of goal difficulty ($r = .42$, $p < .05$).

Cognitive ability and goal orientation. To assess cognitive ability, participants took the Wonderlic Personnel Test (Form IV; Wonderlic & Associates, 1992). The 50-item test is a reliable (e.g., split-half reliability = .88 – .94) and valid measure of general cognitive ability. Participants also completed Button et al.'s (1996) measure of goal orientation. This measure includes eight items that assess learning orientation and eight items that assess performance orientation. As in previous research, internal consistency reliabilities of the scales were good (.78 and .82, respectively).

Team-level variables were formed by taking the within-team average of the members' scores for general cognitive ability, performance orientation, and learning orientation. This additive method of aggregation was used for two reasons. First, the mean for the three variables was correlated highly ($> .75$) with scores for other aggregate measures (highest and lowest scoring members), and, therefore, the alternative measures were largely redundant. Second, the additive model predicts indices of team functioning and effectiveness across different types of task contexts fairly well (Devine & Philips, 2001). To facilitate interpretation of parameters in the presence of interactions and reduce nonessential multicollinearity, the independent variables were mean centered prior to forming the interaction terms.

Role structure adaptation. Because all attribute values were needed to generate valid recommendations and decisions and because Charlie was the only team member who could interpret RCA values, effectively adapting to the communications breakdown required the team to learn how to inform Charlie of the value of RCA. Because Bravo and Charlie could not communicate with each other using text messages and because only the station that originally measured the attribute value could directly transmit

the attribute value to another station, the most efficient way of adapting was such that Bravo directly transmitted the RCA value to Alpha, and then Alpha would send a text message with the RCA value to Charlie. The task was structured this way to ensure that an appropriate adaptation was not overly obvious and would necessarily involve all team members. It was possible for teams to adapt using a less efficient structure (e.g., Charlie queries Alpha for the RCA value, Alpha queries Bravo for the RCA value, Bravo transmits the RCA value to Alpha, Alpha sends the RCA value to Charlie using a text message). However, an analysis showed that the efficiency of the adapted role structure was not important in terms of influencing the accuracy of team decisions. That is, the relationship between an index of communications efficiency and the accuracy of team decisions (for those teams with an adapted structure) was not statistically significant. Moreover, a qualitative examination of the pattern of communication among team members revealed that once teams developed an adapted role structure, the system of roles remained stable until the end of the simulation. With all this in mind, it seemed reasonable to capture role structure adaptation by coding the activity of each team on a trial-by-trial basis with respect to whether Charlie received a text message with the RCA value from Alpha. It is important to stress that Alpha would have had to receive this information from Bravo, and Charlie would have had to inform a team member that he or she was not receiving the information in the first place, so any adaptation would have necessarily involved the entire team. Teams were assigned a score for each of the 20 postchange decision trials, indicating whether the team used an effective adapted role structure for that trial (1 = effectively adapted and 0 = failed to effectively adapt). As a check on the validity of this coding scheme, I obtained ratings from two doctoral-level students of team adaptation using the 8-item scale developed by LePine (2003). The raters agreed with one another about the scores they provided ($ICC_1 = .57, p < .05$), and the mean scale scores were reliable both from internal consistency (mean item $\alpha = .93$) and interrater perspectives ($ICC_2 = .73$). Most important, there was a strong positive relationship between the ratings of adaptation and the total number of trials in which teams used an adapted structure ($r = .61, p < .05$).

Analytic Approach

To take advantage of the repeated measures design (there were 20 opportunities to adapt), I used hierarchical linear modeling (HLM 5.04; Raudenbush, Bryk, Cheong, & Congdon, 2000). HLM is an analytic approach that estimates separate within- and between-units models. The within-units model (Level 1) generates estimates (unit level intercepts and slopes) that are used as dependent variables for the between-units model (Level 2). In the context of the present study, each dependent variable observation is a dichotomy, which means that the assumption of normality of the Level-1 residuals is not met. Accordingly, I specified a hierarchical generalized linear model (HGLM) in which the Level-1 estimates result from the use of a Bernoulli model appropriate for binary outcomes. As in normal logistic regression, the predicted values from the Level-1 model do not refer to levels of Y but to the natural logarithm of the odds that Y will take on a value of 1 (i.e., the team adapted on this trial) rather than a value of 0 (i.e., the team did not adapt on this trial). Because the slopes and intercepts generated from the Level-1 model are continuous and normally distributed, Level-2 parameters are interpreted as in normal regression.

Results

Because adaptation is a result of learning that occurs over time, I specified a Level-1 model used in learning and development contexts (Bryk & Raudenbush, 1992):

$$\text{Log}[\text{odds}(Y_{ij} = 1)] = \beta_{0j} + \beta_{1j}T_{ij} + \beta_{2j}T_{ij}^2 \quad (1)$$

In this model, Y_{ij} is the role structure adaptation score for decision trial i in team j . T_{ij} is the index of time for decision trial i for team

j . T_{ij}^2 is an index of the curvature or acceleration for decision trial i for team j . Although the intercept could potentially be placed anywhere, I coded the 20 trials using 0–19 so that the intercept of Model 1 would represent the likelihood of adaptation at the point at which the change stabilized. The β_{0j} is the intercept that captures the log odds of adaptation for team j when T is 0. Essentially, this value can be thought of as the likelihood of adaptation for team j at the time when the deterioration of the task stabilized. The β_{1j} is the slope that captures the growth rate of adaptation in log odds for team j . This value can be interpreted as the change in the likelihood of adaptation for team j as a function of time. Finally, the β_{2j} is the slope that captures the curvature or acceleration in the rate of adaptation in log odds for team j . This value can be thought of as the increase or decrease in the rate of change in the likelihood of adaptation for team j as a function of time.

Preliminary Level-1 Results

Prior to specifying a Level-2 model to test the hypotheses, I ran an unconditional model with no Level-2 predictors in order to estimate the mean intercept, slope, and acceleration. To facilitate interpretation of the estimates, I converted the betas, which are log odds, into probabilities:

$$\text{Probability}(Y = 1) = \exp\{\beta\}/(1 + \exp\{\beta\}). \quad (2)$$

The estimated mean intercept ($\beta_{0j} = -.93, p < .05$) indicated that the probability of role structure adaptation at the time at which the change stabilized was .28. The estimated linear time effect was also statistically significant. With each subsequent trial after the change stabilized, the log odds of adapting increased by $\beta_{1j} = .14$ ($p < .05$). However, the estimated curvilinear effect of time was negative and also statistically significant ($\beta_{2j} = -.003, p < .05$). Thus, the rate of increase in the likelihood of adaptation decreased slightly over time. In the 10th trial after the change stabilized ($T = 9$), for example, the log odds of adapting increased by $.11 [(.14 + (9 \times -.003))]$ rather than by $.14$, and, therefore, the estimated probability of adaptation at that time was $.52 [\exp(-.93 + \{9 \times .11\})/(1 + \exp\{-.93 + (9 \times .11)\})]$. These results are consistent with Figure 1, which is a plot of the number of teams using an adapted structure across the 20 postdisruption trials. Overall, this pattern suggests that adaptation to the unforeseen change in this task did not require an adaptation that was too simplistic (i.e., only about 50% of the teams used an adapted structure 10 trials after the

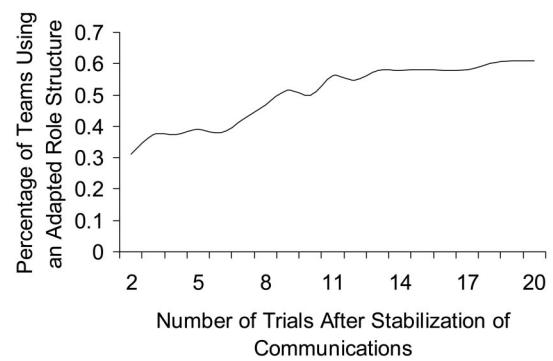


Figure 1. Role structure adaptation as a function of experience.

disruption stabilized), and teams were given an adequate number of opportunities to adapt (i.e., the increase in the likelihood of adaptation leveled off by Trial 83).

The primary results of interest in the context of the present study are the parameter estimates for the between-teams variables (goal difficulty and team composition with respect to general cognitive ability, learning orientation, and performance orientation). Because the Level-1 intercepts (β_{0j}) and slopes (β_{1j}, β_{2j}) from Equation 1 are dependent variables for the Level-2 model, I specified the following Level-2 models to assess the study hypotheses:

$$\begin{aligned} \beta_{0j} = & \gamma_{00} + \gamma_{01}(\text{goal difficulty}) + \gamma_{02}(\text{cognitive ability}) \\ & + \gamma_{03}(\text{learning orientation}) + \gamma_{04}(\text{performance orientation}) \\ & + \gamma_{05}(\text{Goal} \times \text{Cognitive Ability}) \\ & + \gamma_{06}(\text{Goal} \times \text{Learning Orientation}) \\ & + \gamma_{07}(\text{Goal} \times \text{Performance Orientation}) + u_{0j}. \quad (3) \end{aligned}$$

$$\begin{aligned} \beta_{1j} = & \gamma_{10} + \gamma_{11}(\text{goal difficulty}) + \gamma_{12}(\text{cognitive ability}) \\ & + \gamma_{13}(\text{learning orientation}) + \gamma_{14}(\text{performance orientation}) \\ & + \gamma_{15}(\text{Goal} \times \text{Cognitive Ability}) \\ & + \gamma_{16}(\text{Goal} \times \text{Learning Orientation}) \\ & + \gamma_{17}(\text{Goal} \times \text{Performance Orientation}) + u_{1j}. \quad (4) \end{aligned}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}. \quad (5)$$

The γ parameters capture effects of the study variables on the likelihood of role structure adaptation, both at the point at which the change stabilized β_{0j} and as a function of experience with the task after the change stabilized β_{1j} . There are also three error terms included in Equations 3, 4, and 5. u_{0j} reflects variation in team differences on their level of role structure adaptation and, therefore, accounts for a source of correlated error. u_{1j} and u_{2j} reflect variation in the slopes and, thus, account for serially correlated error. Finally, although the nonlinearity in the slopes was necessary to include in the Level-1 model (i.e., β_{2j} was statistically significant), I did not attempt to predict this nonlinearity in a Level-2 model because the variance estimate for the slopes that capture nonlinearity (u_{2j}) was not significant either in the unconditional model or in models that included Level-2 predictors of β_{0j} .

and β_{1j} . Moreover, the β_{1j} and β_{2j} terms were largely redundant ($r = .93$), and, thus, too little could be gained at the cost of seven additional degrees of freedom.

Preliminary Between-Team Results

Table 1 includes descriptive statistics and correlations among team-level variables, some of which are included for comparison with past research. The importance of having an adapted role structure was supported by a significant relationship between the total number of trials teams used as an adapted structure and for team decision-making performance with respect to the overall accuracy of team decisions (operationalized as the reverse of the mean-squared error so that higher scores indicate higher decision-making performance). Table 1 also indicates that although predisruption decision-making performance was positively associated with postdisruption decision-making performance, predisruption decision-making performance was not associated with the extent to which teams used an adapted role structure. Although this pattern of relationships does not support the paradox of success (an inverse relationship between pre- and postchange performance), as described by Audia, Locke, and Smith (2000), the pattern does support findings suggesting that performance during routine and changing (or familiar and novel) task contexts are clearly not the same thing (LePine et al., 2000; Ployhart & Hakel, 1998).

Table 1 also shows that goal difficulty was positively associated with team decision-making performance in the routine task context. Specifically, in the 20 trials prior to when the communications began to deteriorate, teams with difficult goals made decisions that were more accurate than teams with easy goals ($r = .17, p < .10$, one-tailed). Although the correlation between team goal difficulty and postchange decision-making performance was not statistically significant ($r = -.10$), it was significantly lower than the correlation with prechange performance ($r_{\text{difference}} = -.27, p < .10$). Goal difficulty was not significantly related to any of the team composition variables; thus, random assignment to goal conditions appeared to have worked as expected. Aggregated team member cognitive ability was not significantly related to either aggregated goal orientation variable. Finally, the aggregated learning and performance orientation variables were not related.

Table 1
Descriptive Statistics and Correlations

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Goal difficulty	0.50	0.50	—						
2. Members' cognitive ability ^a	23.56	2.51	-.01	—					
3. Members' learning orientation ^a	3.93	0.41	-.00	.10	—				
4. Members' performance orientation ^a	3.83	0.48	-.04	-.13	.03	—			
5. Number of adapted trials	9.84	8.18	.02	.42*	.31*	-.24*	—		
6. Prechange decision-making performance	6.18	0.53	.17†	.24*	-.20†	-.02	.14	—	
7. Postchange decision-making performance	5.25	1.05	-.10	.36*	.13	-.03	.28*	.38*	—

Note. *N* = 64.

† $p < .10$, one-tailed. * $p < .05$, one-tailed.

^a Descriptive statistics for uncentered variables.

Results of Level-2 Analyses: Testing the Hypotheses

Table 2 shows the results for the HGLM model that included the Level-2 predictors of both the intercept and the linear slope. Because the predictors were mean centered, each first order coefficient can be interpreted in the presence of the interactions as the average regression of the criterion on the predictor across the range of the other predictors (Cohen, Cohen, West, & Aiken, 2003, p. 262).

Hypothesis 1 was supported in that teams comprising members possessing higher cognitive ability had a higher likelihood of adaptation by the time the deterioration stabilized (i.e., $\gamma_{02} = .213$, $p < .05$). Substituting the appropriate values into the intercepts portion of the model revealed that relative to teams with low-cognitive ability members (mean cognitive ability = -1 standard deviation), teams with high-cognitive ability members (mean cognitive ability = +1 standard deviation) were 37% more likely to have an adapted role structure by the time the change stabilized (.21 vs. .30). Teams with higher cognitive ability members were not more likely to adapt at higher rates once the deterioration stabilized, however ($\gamma_{12} = .003$, ns). Goal difficulty by itself did not influence role structure adaptation because the γ_{01} and γ_{11} terms predicting the intercept and slope were not statistically significant. However, Hypothesis 2 suggested that team composition in terms of cognitive ability would moderate the goal difficulty–role structure adaptation relationship. This hypothesis was not supported because neither γ_{05} nor γ_{15} was statistically significant.

Hypothesis 3 was not supported in that there was no main effect of members' learning orientation on the likelihood of role structure adaptation, either by the end of the disruption or as a function of time. However, Hypothesis 4 was supported because team composition in terms of learning orientation moderated the goal difficulty–role structure adaptation relationship ($\gamma_{16} = .243$, $p <$

.05) in a manner that was consistent with the prediction. The plot in Figure 2 shows that the relationship between goal difficulty and the rate of adaptation was more positive for teams comprising members high in learning orientation. The importance of this effect can be better appreciated by considering that by the 10th trial after the disruption stabilized, teams with members possessing high-learning orientation were 1.66 times more likely to adapt to difficult goals rather than to easy goals, whereas teams with members possessing low-learning orientation were about 3 times less likely to adapt if they had difficult goals rather than if they had easy goals.

Hypothesis 5 was not supported because performance orientation did not have an effect on adaptation either by the time the disruption stabilized or as a function of time. However, the results in Table 2 show that performance orientation did moderate the relationship between goal difficulty and role structure adaptation ($\gamma_{07} = -2.415$, $p < .05$). Specifically, performance orientation influenced the relationship between goal difficulty and the likelihood of role structure adaptation at the time the change stabilized. The plot of the interaction depicted in Figure 3 supports Hypothesis 6 because the relationship between goal difficulty and the likelihood of role structure adaptation was less positive for teams comprising members high in performance orientation than for teams comprising members low in performance orientation. As with the moderating effect of members' learning orientation, differences in the level of members' performance orientation resulted in substantial differences in the effects of goal difficulty in the likelihood of adaptation. For teams with members possessing high-performance orientation, the likelihood of adaptation following the disruption was 23% with easy goals; however, the likelihood of adaptation was only 3% when teams with high-performance orientation members were assigned difficult goals. Conversely, for teams with members possessing low-performance orientation, the likelihood of adaptation was two and a half times greater with difficult goals than with easy goals.

Table 2
Tests of Study Hypotheses

Variable	Coefficient	SE
Intercept predictions, β_{0j}		
Initial adaptation (intercept), γ_{00}	-1.012*	0.196
Goal (GL), γ_{01}	-0.098	0.373
Cognitive ability (CA), γ_{02}	0.213*	0.086
Learning orientation (LO), γ_{03}	0.370	0.417
Performance orientation (PO), γ_{04}	-0.189	0.453
GL \times CA, γ_{05}	0.116	0.171
GL \times LO, γ_{06}	-1.126	0.834
GL \times PO, γ_{07}	-2.415*	0.906
Slope predictions, β_{1j}		
Time (intercept), γ_{10}	0.147*	0.032
GL, γ_{11}	0.002	0.021
CA, γ_{12}	0.003	0.004
LO, γ_{13}	-0.013	0.030
PO, γ_{14}	-0.028	0.024
GL \times CA, γ_{15}	-0.007	0.010
GL \times LO, γ_{16}	0.243*	0.060
GL \times PO, γ_{17}	0.067	0.048
Slope predictions, β_{2j}		
Acceleration (intercept), γ_{20}	-0.004*	0.001

Note. Approximate $df = 56$ for intercept and slope predictors.

* $p < .05$.

Supplemental Analyses

Among advantages of the task used in this study is that the TIDE² software maintained a record of the text message communications that occurred among members. This record of team communications provided an opportunity to conduct supplemental analyses aimed at developing a deeper understanding of the observed relationships among variables because communications among members reflect the nature of team functioning. The supplemental analyses began with two doctoral-level students rating the communications of teams with respect to the three types of processes outlined by Marks et al. (2001) during three different phases of team activity: prior to the communications disruption (posttraining: Trials 6–43), during the communications disruption (Trials 44–63), and after the communications stabilized (Trials 64–83). To measure *interpersonal processes*, I used three items adapted from those included in the Team Spirit and Morale Scale (Oser, McCallum, Salas, & Morgan, 1989): "Members of this team did NOT make negative comments about the team, other members of the team, or the team's task"; "Members of this team were polite and respectful toward one another"; "Members of this team supported members who had made a mistake or had problems". To measure *transition processes*, I developed three items that reflect

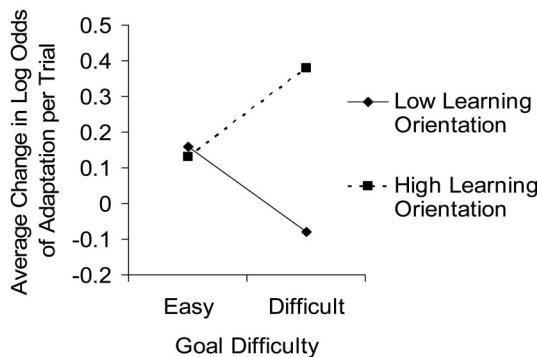


Figure 2. Plot of the Goal Difficulty \times Learning Orientation interaction.

the “mission analysis, formulation, and planning” dimension using the definition provided by Marks et al. (2001) and referring to items from Oser et al. (1989): “Members of this team openly communicated with one another regarding potential alternative courses of action”; “Members of this team made constructive suggestions regarding different ways of doing the team’s task”; “Members of this team exchanged information with one another in order to diagnose the cause of problems or discrepant information”. Finally, I measured the “monitoring progress toward goals” aspect of *action processes* using three items I developed on the basis of the definition provided by Marks et al. (2001): “Members of this team communicated about how the team was doing relative to the team’s assigned goal”; “Members of this team expressed concern regarding the team’s performance progress”; “Members of this team offered evaluations of how well the team was performing”. The general expectation guiding the supplemental analyses was that these processes, particularly during the disruption, would be positively associated with adaptation and also that these processes would be higher in teams with difficult goals and with members possessing higher learning orientation and lower in teams with difficult goals and with members possessing higher performance orientation.

Overall, and as the descriptive statistics and correlations in Table 3 show, the scales exhibited decent psychometric properties. First, the two raters agreed with one another about the ratings they provided (all ICC1s $\geq .48$, $p < .05$). Second, using the mean item scores, the scales were reliable from an internal consistency perspective (alphas ranged between .68 and .85). Third, the mean of the two ratings for each scale was reliable (ICC2s ranged from .65 to .82). Finally, the measures appeared to be sufficiently unique with respect to both the type of process indicated and the phase of activity. With the exception of transition and action processes prior to the disruption, relationships among these processes tended to be lower than what would indicate overwhelming conceptual and empirical redundancy.

Identifying processes that predict adaptation. To identify the processes that predicted adaptation, I ran three HGLM models. Adaptation was predicted in the first model by using the measures reflecting prechange processes, in the second model by using the measures reflecting processes during the disruption, and finally, in the third model by using the measures reflecting processes after the disruption had stabilized.

The results of these HGLM analyses appear in Table 4 and reveal that team processes prior to the change did not predict the likelihood of adaptation either before or after the change stabilized. The likelihood of adaptation at the point at which the disruption stabilized was predicted, however, by team processes measured during the disruption. Of most interest, whereas interpersonal and transition processes during the disruption period had a positive effect on the likelihood of adaptation, action processes had a negative effect. That is, teams were more likely to have adapted by the time the disruption ended if the communications among team members during the disruption reflected a positive interpersonal tone and a focus on analysis and planning rather than monitoring the progress of performance. There was also a significant positive relationship between transition processes during the disruption period and the slopes. In other words, teams that analyzed the situation and planned more during the disruption had higher rates of adaptation once the disruption stabilized. Finally, during the postdisruption period, the only significant adaptation effect was with action processes. Of most interest, however, is whereas monitoring performance progress during the disruption period was detrimental with respect to the likelihood of adaptation, the same team-level activity actually promoted the likelihood of adaptation after the disruption had stabilized.

Predicting the relevant processes. In the next phase of this supplemental analysis, I examined the extent to which the team composition variables and goal difficulty predicted the processes that predicted adaptation (i.e., interpersonal, transition, and action processes during the disruption period and action processes during the postdisruption period). Because the predictors and criteria are continuous team-level variables, I performed the analysis using ordinary least squares regression. Results of the statistically significant models appear in Table 5.

The first column of statistics in Table 5 shows the results of the regression of interpersonal processes during the disruption. There was a significant positive main effect for members’ learning orientation. There was also a significant interaction of team composition with respect to performance orientation and goal difficulty. The plot of this interaction appears in Figure 4 and illustrates that goal difficulty had a more negative effect on interpersonal processes for teams with members scoring high on performance orientation. Teams with difficult goals and comprising members with high-performance orientation were rated as having especially poor interpersonal processes during the disruption.

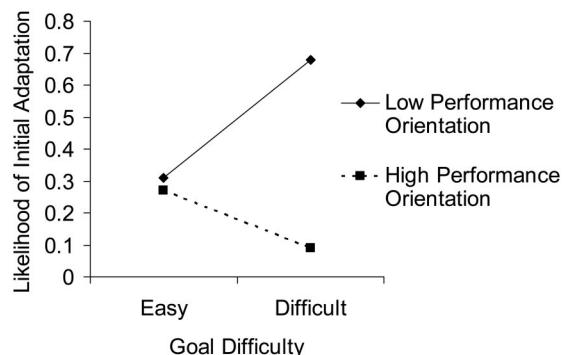


Figure 3. Plot of the Goal Difficulty \times Performance Orientation interaction.

Table 3
Descriptive Statistics and Correlations Among Team Process Variables

Variable	<i>M</i>	<i>SD</i>	ICC1	ICC2	1	2	3	4	5	6	7	8	9
1. Predisruption interpersonal processes	2.51	0.48	.58	.74	.82								
2. Predisruption transition processes	1.46	0.35	.51	.68	.43*	.77							
3. Predisruption action processes	1.51	0.39	.50	.67	.42*	.76*	.79						
4. Disruption interpersonal processes	2.83	0.64	.65	.79	.23*	.12	.16	.85					
5. Disruption transition processes	3.59	0.81	.69	.82	.01	.11	.16	.13	.83				
6. Disruption action processes	2.45	0.51	.63	.77	.15	.25*	.31*	.22*	.36*	.70			
7. Postdisruption interpersonal processes	3.01	0.44	.48	.65	.36*	.22*	.25*	.21*	.14	.36*	.74		
8. Postdisruption transition processes	2.22	0.37	.51	.68	.21*	.19†	.19†	.12	.34*	.43*	.15	.68	
9. Postdisruption action processes	2.28	0.46	.57	.73	-.03	.15	-.06	.18†	.40*	.52*	.27*	.49*	.69

Note. *N* = 64. Internal consistency reliabilities, based on the mean of the ratings for each item, are shown along the diagonal. ICC = intraclass correlation. † *p* < .10, one-tailed. * *p* < .05, one-tailed.

The second column of statistics in Table 5 shows the results of the regression of transition processes during the disruption period. First, although there was a significant positive main effect for team members' learning orientation, there was also an interaction of members' learning orientation with goal difficulty. The plot of this interaction appears in Figure 5 and suggests that goal difficulty had a positive impact on transition processes for teams with members scoring high in learning orientation and a negative impact on transition processes for teams with members scoring low in learning orientation. There was also an interaction of goal difficulty and members' performance orientation. The plot of this interaction, depicted in Figure 6, suggests that goal difficulty had a negative influence on transition processes for teams comprising members with a high-performance orientation and a positive influence on transition processes for teams with members scoring low in performance orientation.

The overall model predicting action processes during the disruption was not significant. However, there was a positive zero-order relationship with team composition with respect to members' performance orientation ($r = .26$, $p < .05$). That is, teams with members scoring high in performance orientation tended to communicate more about the team goal and how the team was performing relative to that goal. Recall, however, that communication

of this nature during the disruption was negatively associated with team adaptation.

Finally, the results of the regression of action processes after the disruption stabilized appear in the third column of statistics in Table 5. First, there was an interaction of team composition in terms of learning orientation and goal difficulty. The pattern of this interaction, plotted in Figure 7, reveals that goal difficulty was positively associated with action processes for teams with high-learning orientation members and negatively associated with action processes for teams with low-learning orientation members. There was also an interaction of members' performance orientation and goal difficulty. The plot depicted in Figure 8 shows that higher goal difficulty resulted in lower action processes in teams comprising high-performance orientation members and higher action processes in teams comprising low-performance orientation members. These interactions are important because after the disruption stabilized, communications regarding performance promoted the likelihood of subsequent adaptation.

Summary of supplemental analyses. These supplemental analyses provided some insight into why having difficult goals detracted from adaptation in teams with high-performance orientation members and why the same difficult goals promoted adaptation in teams with high-learning orientation members. Dur-

Table 4
Supplemental HGLM Analyses

Variable	Predisruption		Disruption		Postdisruption	
	Coefficient	<i>SE</i>	Coefficient	<i>SE</i>	Coefficient	<i>SE</i>
Intercept predictions, β_{0j}						
Initial adaptation (intercept), γ_{00}	-0.783	1.266	-5.855*	1.110	-2.694	1.865
Interpersonal processes, γ_{01}	0.243	0.466	1.158*	0.292	0.142	0.541
Transition processes, γ_{02}	-0.377	0.975	1.191*	0.178	-0.029	0.701
Action processes, γ_{03}	-0.135	0.894	-1.084*	0.322	0.614	0.482
Slope predictions, β_{1j}						
Time (intercept), γ_{10}	0.243	0.072	0.013	0.091	0.070	0.114
Interpersonal processes, γ_{11}	-0.052	0.035	-0.030	0.027	-0.028	0.027
Transition processes, γ_{12}	0.038	0.072	0.060*	0.013	-0.023	0.031
Action processes, γ_{13}	-0.018	0.060	0.001	0.027	0.089*	0.030
Slope predictions, β_{2j}						
Acceleration (intercept), γ_{20}	-0.003*	0.001	-0.004*	0.002	-0.003*	0.004

Note. Approximate *df* = 60. HGLM = hierarchical generalized linear model.

* *p* < .05.

Table 5
Supplemental Regression Analyses

Variable	Interpersonal processes during disruption			Transition processes during disruption			Action processes postdisruption		
	β	<i>t</i>	<i>F</i> (7, 56)	β	<i>t</i>	<i>F</i> (7, 56)	β	<i>t</i>	<i>F</i> (7, 56)
Goal difficulty (1)	-.02	-0.14		.24*	2.09		.16	1.36	
Members' cognitive ability (2)	-.11	-0.83		-.02	-0.14		-.07	0.57	
Members' learning orientation (3)	.31*	2.31		.23†	1.75		-.05	-0.38	
Members' performance orientation (4)	.05	0.37		-.05	0.38		.04	0.33	
1 × 2	.01	0.11		-.07	-0.60		-.04	-0.31	
1 × 3	-.10	-0.76		.23†	1.79		.43*	3.16	
1 × 4	-.36*	2.74	2.28	-.31*	2.52	3.39	-.26*	2.03	2.34
Total <i>R</i> ²	.22*			.30*			.23*		

Note. N = 64.

† $p < .10$. * $p < .05$.

ing the disruption, teams with high-performance orientation members and difficult goals communicated in a manner that detracted from team spirit and morale, and the focus of these teams' communications appeared to be more about how the disruption would affect progress of performance and less about possible actions the team should take in order to cope with the disruption itself. After the disruption stabilized, these teams seemed to withdraw from the task in that even communications regarding performance progress decreased. The type of activity in teams with high-learning orientation members and difficult goals, however, was vastly different. During the disruption, members of these teams communicated in a positive interpersonal manner, and the focus of this communication was on analyzing the situation and planning how to cope with it effectively. Moreover, after the disruption, these teams persisted in the task and engaged in more monitoring of the teams' performance. In summary, the results of this supplemental analysis suggest that team goal difficulty and team members' goal orientation work jointly in determining whether teams are likely to engage in adaptive or maladaptive behavior patterns, as reflected in the team processes. In the context of the Kozlowski et al. (1999) theory, the joint impact of these variables appear to work through effects on processes that likely determine the extent to which teams are capable of compiling the type of knowledge needed to invent new networks or systems of roles in response to a changing task context.

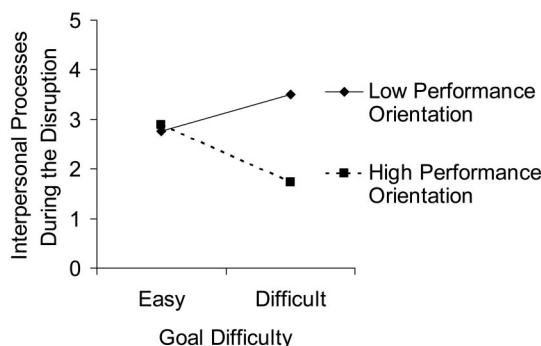


Figure 4. Plot of Goal Difficulty × Performance Orientation interaction predicting interpersonal processes.

Discussion

The present research was conducted in order to examine the degree to which team composition influences effects of team goals on team functioning in circumstances in which the team has to adapt to an unforeseen change in its task context. Results of the study showed that effects of team goal difficulty were completely dependent on members' goal orientation and also that these effects operate through at least three types of team processes. As discussed in the following section, results of the study have implications for both theory and practice.

Theoretical and Practical Implications

Although prior research supported the idea that difficult goals promote the performance of individuals and teams in routine contexts and that difficult goals may be less efficacious or deleterious in novel or complex tasks, this issue has not been directly examined before in a team context in which unforeseen change creates the novelty and complexity that requires on-the-fly network invention. This research is also the first to examine the possibility that team composition with respect to members' cognitive ability and goal orientation may influence effects of difficult team goals in changing task contexts. Results of this study indicated that goal difficulty did not have an independent effect on

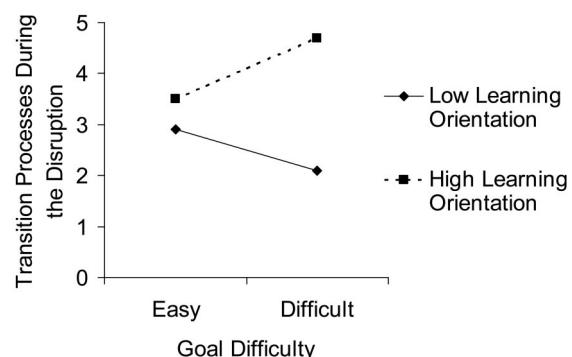


Figure 5. Plot of Goal Difficulty × Learning Orientation interaction predicting transition processes.

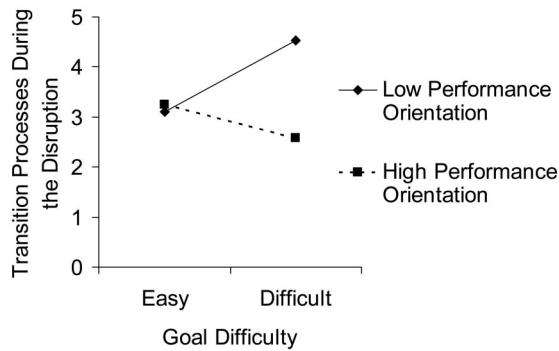


Figure 6. Plot of Goal Difficulty \times Performance Orientation interaction predicting transition processes.

team adaptation but instead depended entirely on the composition of teams given their members' goal orientation. Goal difficulty inhibited adaptation of teams comprising members possessing high-performance orientation and promoted adaptation of teams comprising members possessing high-learning orientation.

A second contribution of this study is that the findings support prior research, suggesting that negative goal effects in novel or complex contexts may manifest from inappropriate strategies and suboptimal learning (DeShon & Alexander, 1996). Indeed, the supplemental analyses illustrated that difficult goals were problematic for teams comprising members who score high on performance orientation because during the change, these teams tended to focus attention on how the team was doing relative to their goal, and these teams did not share the type of information necessary for learning and developing appropriate strategies. The results of the supplemental analyses also suggested that difficult goals may actually promote effectiveness of teams in a novel or changing task context through effects on learning and strategies. However, this positive effect was only observed for teams comprising members possessing high-learning orientation. Teams configured this way tended to be more cooperative, shared problem-relevant information with one another, and made and evaluated suggestions about alternative ways of doing the task in light of the new situation.

A third contribution of the study is that it is one of the first to consider empirically the temporal nature of team adaptation. This is perhaps most clearly illustrated in the analysis predicting the

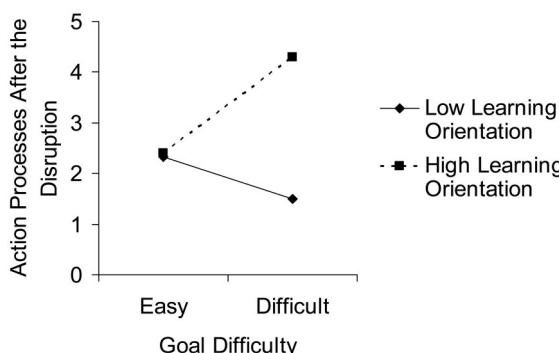


Figure 7. Plot of Goal Difficulty \times Learning Orientation interaction predicting action processes.

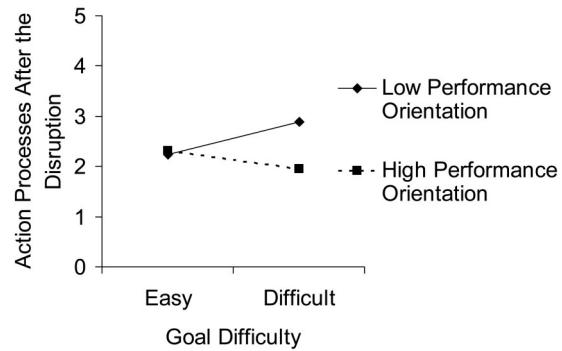


Figure 8. Plot of Goal Difficulty \times Performance Orientation interaction predicting action processes.

slopes, or differences in teams' rates of adaptive learning over time. In addition, however, the study design allowed for insight into phases of team activity prompted by changes in the task. Although the exact boundary may have been less defined than that for the initial disruption, the stabilization of the communications represented a natural transition point in that the uncertainty of the situation should have been reduced, and this is the point at which I had expected to see variability begin with respect to role structure adaptation. Of most interest, the primary results indicated that different factors predicted adaptation in these two time periods, and the results of the supplemental analyses illustrated why these results may have occurred. I acknowledge that, in hindsight, it may have been possible to hypothesize distinct cross-level effects for the interaction of goal difficulty and the two team composition variables across these two periods. However, differential predictions for phases of activity would require the specification of even more complex interactive effects, not only in that phases of activity represent an additional variable to model but also in that the trial-level observations are conceptually and empirically nested within phases of activity. Given the state of the literature, developing and theoretically supporting such complex interactions would have been rather tenuous. Moreover, given the size of the sample, inferences from empirical tests of such complex interactions would have been somewhat questionable. Taken together, however, the results of the present study suggest that theoretical and empirical research on team adaptation would be well served by considering effects during different phases of activity explicitly and directly.

Finally, findings of the present research have several practical implications. First, the results of the study appear to support the utility of practices that incorporate goal setting even in circumstances in which teams may need to adapt in order to cope with unforeseen change. However, the study findings also suggest that before implementing goal-setting practices in such contexts, managers should consider assessing team composition with respect to members' goal orientation to ensure that there is alignment (i.e., members possess high-learning orientation and perhaps low-performance orientation). Second, in addition to well-known individual differences, such as general cognitive ability and conscientiousness, team staffing practices may be improved by considering individual differences in goal orientation. Given that teams can set their own difficult goals, staffing that considers members' goal

orientation may have application beyond those organizational contexts in which explicit goal-setting practices are used. Finally, practitioners interested in promoting team adaptation could attempt to leverage directly the types of processes that were identified in the supplemental analyses. For example, training that reinforces the importance of behaviors that support interpersonal and transition processes during times of rapid change may be beneficial with respect to team adaptation. Of course, before the results of the present research are used as a basis for any organizational decisions, research needs to be conducted in an array of more naturalistic team settings.

Limitations

One limitation of the present research is that the task and setting may limit the generalizability of the results. However, the laboratory was appropriate in the context of the present research because the purpose of the study was to examine theoretical questions that have not been addressed before. The concern was less about estimating precise effect sizes and more about whether the predictors would have effects in the expected directions. Although it is not likely that our participants developed a strong identity with their roles or experienced the type of pressure that characterizes real-world command-and-control contexts, there were real consequences for performing well in the study, and participants were highly involved with the task and visibly upset when they performed poorly. Thus, the task had some degree of psychological realism (Berkowitz & Donnerstein, 1982; Carlsmith, Ellsworth, & Aronson, 1976). Finally, there is meta-analytic support that suggests that laboratory findings generalize fairly well across an array of psychological domains, including aggression, helping, leadership style, social loafing, self-efficacy, and depression (Anderson, Lindsay, & Bushman, 1999).

A second limitation is that the research did not explicitly examine a more inclusive model with respect to predictors and outcomes. With respect to predictors, there is research suggesting that performance orientation may consist of two dimensions, and it is conceivable that these dimensions operate differently. Specifically, VandeWalle (1997) suggested that the desire to "prove" one's competence is distinct from the desire to "avoid" the disproving of one's competence, and, therefore, it may have been worthwhile to assess whether team composition with respect to both dimensions interact with goal difficulty the same way in influencing team adaptation. Although the use of the Button et al. (1996) measure in the present study is consistent with other recent research published in the *Journal of Applied Psychology* (e.g., Bell & Kozlowski, 2002; Yeo & Neal, 2004), future research should consider the utility of considering measures that cleanly tap the prove and avoid aspects of performance orientation. With respect to outcomes, researchers could consider aspects of team effectiveness, such as member satisfaction or team viability, that were not included in the present study. For example, although team members are likely to experience elevated levels of stress in response to demands associated with unforeseen change, this stress may reflect feelings of challenge, which, in turn, may increase satisfaction with and commitment to the team and its task (LePine, LePine, & Jackson, 2004; LePine, Podsakoff, & LePine, 2005).

Conclusion

Beyond addressing the specific limitations noted in the previous paragraph, future research could extend the present work in several ways in order to move researchers' knowledge of network invention and team adaptation further. First, researchers could focus more directly on the types of team processes that contribute to adaptation during different phases of experience or time. The typology of team processes, proposed by Marks et al. (2001), and the theory of adaptation, proposed by Kozlowski et al. (1999), could be used as the basis for future research along these lines. Second, researchers could examine the nature of the knowledge that individuals, dyads, and teams compile as a function of experience in settings in which adaptation may be required. Again, Kozlowski et al.'s (1999) theory may be useful in that it offers testable propositions related to the content of this knowledge across levels of theory. Finally, researchers could consider alternative ways in which the characteristics and behaviors of individual team members influence the processes involved in team adaptation. For example, traits of team members influence how their peers respond affectively and behaviorally to them, and ultimately these responses may influence the nature and quality of interaction among team members (Jackson & LePine, 2003; LePine & Van Dyne, 2001). Given the prevalence of teams that exist in environments in which network invention and adaptation may be required, research on these types of issues would be very worthwhile.

References

- Anderson, C. A., Lindsay, J. J., & Bushman, B. J. (1999). Research in the psychological laboratory: Truth or triviality? *Current Directions in Psychological Science*, 8, 3–9.
- Arrow, H. (1997). Stability, bistability, and instability in small group influence patterns. *Journal of Personality and Social Psychology*, 72, 75–85.
- Audia, P. G., Locke, E. A., & Smith, K. G. (2000). The paradox of success: An archival and a laboratory study of strategic persistence following radical environmental change. *Academy of Management Journal*, 43, 837–853.
- Behling, O., Coady, N., & Hopple, T. G. (1967). Small group adaptation to unprogrammed change. *Organizational Behavior and Human Performance*, 2, 73–83.
- Bell, B. S., & Kozlowski, S. W. J. (2002). Goal orientation and ability: Interactive effects on self-efficacy, performance, and knowledge. *Journal of Applied Psychology*, 87, 497–505.
- Berkowitz, L., & Donnerstein, E. (1982). External validity is more than skin deep. *American Psychologist*, 37, 245–257.
- Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis models*. Newbury Park, CA: Sage.
- Bunderson, J. S., & Sutcliffe, K. M. (2003). Management team learning orientation and business unit performance. *Journal of Applied Psychology*, 88, 552–560.
- Button, S. B., Mathieu, J. E., & Zajac, D. M. (1996). Goal orientation in organizational research: A conceptual and empirical foundation. *Organizational Behavior and Human Decision Processes*, 67, 26–48.
- Campion, M. A., & Lord, R. G. (1982). A control systems conceptualization of the goal-setting and changing process. *Organizational Behavior and Human Decision Processes*, 30, 265–287.
- Carlsmith, J. M., Ellsworth, P. C., & Aronson, E. (1976). *Methods of research in social psychology*. Reading, MA: Addison Wesley.
- Chan, D. (2000). Understanding adaptation to changes in the work environment: Integrating individual differences and learning perspectives. In

- G. R. Ferris (Ed.), *Research in personnel and human resources management* (pp. 1–42). New York: Elsevier Science.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum.
- DeShon, R. P., & Alexander, R. A. (1996). Goal setting effects on implicit and explicit learning of complex tasks. *Organizational Behavior and Human Decision Processes*, 65, 18–36.
- DeShon, R. P., Kozlowski, S. W. J., Schmidt, A. M., Milner, K. R., & Wiechmann, D. (2004). A multilevel, multiple goal model of feedback effects on the regulation of individual and team performance. *Journal of Applied Psychology*, 89, 1035–1056.
- Devine, D. J., & Philips, J. L. (2001). Do smarter teams do better? A meta-analysis of cognitive ability and team performance. *Small Group Research*, 32, 507–532.
- Diener, C. I., & Dweck, C. S. (1978). An analysis of learned helplessness: Continuous changes in performance, strategy, and achievement cognitions following failure. *Journal of Personality and Social Psychology*, 36, 451–462.
- Earley, P. C., Connolly, T., & Ekegren, G. (1989). Goals, strategy development, and task performance: Some limits on the efficacy of goal setting. *Journal of Applied Psychology*, 74, 24–33.
- Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54, 5–12.
- Hackman, J. R. (1987). The design of work teams. In J. W. Lorsch (Ed.), *Handbook of organizational behavior* (pp. 315–342). Englewood Cliffs, NJ: Prentice Hall.
- Hartigan, J. A., & Wigdor, A. K. (1989). *Fairness in employment testing: Validity generalization, minority issues, and the general aptitude test battery*. Washington, DC: National Academy Press.
- Heslin, R. (1964). Predicting group task effectiveness from member characteristics. *Psychological Bulletin*, 62, 248–256.
- Hollenbeck, J. R., Ilgen, D. R., Sego, D., Hedlund, J., Major, D. A., & Phillips, J. (1995). The multilevel theory of team decision making: Decision performance in teams incorporating distributed expertise. *Journal of Applied Psychology*, 80, 292–316.
- Howard, A. (1995). *The changing nature of work*. San Francisco: Jossey-Bass.
- Hunter, J. E. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. *Journal of Vocational Behavior*, 29, 340–362.
- Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternate predictors of performance. *Psychological Bulletin*, 96, 72–98.
- Hutchins, E. (1996). Organizing work by adaptation. In M. D. Cohen & L. S. Sproull (Eds.), *Organizational learning* (pp. 20–57). Thousand Oaks, CA: Sage.
- Jackson, C., & LePine, J. A. (2003). Peer responses to the weakest link: A test of LePine and Van Dyne's model. *Journal of Applied Psychology*, 88, 459–475.
- Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology*, 74, 657–690.
- Klein, H. J. (1989). An integrated control theory model of work motivation. *Academy of Management Review*, 14, 150–172.
- Kozlowski, S. W. J., Gully, S. M., Nason, E. R., & Smith, E. M. (1999). Developing adaptive teams: A theory of compilation and performance across levels and time. In D. R. Ilgen & E. D. Pulakos (Eds.), *The changing nature of performance: Implications for staffing, motivation and development* (pp. 240–292). San Francisco: Jossey-Bass.
- Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes*, 50, 212–247.
- LePine, J. A. (2003). Team adaptation and postchange performance: Effects of team composition in terms of members' cognitive ability and personality. *Journal of Applied Psychology*, 88, 27–39.
- LePine, J. A., Colquitt, J. A., & Erez, A. (2000). Adaptability to changing task contexts: Effects of general cognitive ability, conscientiousness, and openness to experience. *Personnel Psychology*, 53, 563–593.
- LePine, J. A., Hollenbeck, J. R., Ilgen, D. R., & Hedlund, J. (1997). Effects of individual differences on the performance of hierarchical decision-making teams: Much more than g. *Journal of Applied Psychology*, 82, 803–811.
- LePine, J. A., LePine, M. A., & Jackson, C. (2004). Challenge and hindrance stress: Relationships with exhaustion, motivation to learn, and learning performance. *Journal of Applied Psychology*, 89, 883–891.
- LePine, J. A., Podsakoff, N. P., & LePine, M. A. (2005). A meta-analytic test of the challenge stressor—hindrance stressor framework: An explanation for inconsistent relationships among stressors and performance. *Academy of Management Journal*, 48, 764–775.
- LePine, J. A., & Van Dyne, L. (2001). Peer responses to low performers: An attributional model of helping in the context of groups. *Academy of Management Review*, 26, 67–84.
- Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, 26, 356–376.
- Marks, M. A., Zaccaro, S. J., & Mathieu, J. E. (2000). Performance implications of leader briefings and team-interaction training for team adaptation to novel environments. *Journal of Applied Psychology*, 85, 971–986.
- O'Leary-Kelly, A. M., Martocchio, J. J., & Frink, D. D. (1994). A review of the influence of group goals on group performance. *Academy of Management Journal*, 37, 1285–1301.
- O'Reilly, C. A., & Pfeffer, J. (2000). *Hidden value: How great companies achieve extraordinary results with ordinary people*. Boston: Harvard Business School Press.
- Oser, R., McCallum, G. A., Salas, E., & Morgan, B. B., Jr. (1989). *Toward a definition of teamwork: An analysis of critical team behaviors* (Tech. Rep. No. 89-004). Orlando FL: Human Factors Division, Naval Training Systems Center.
- Ployhart, R. E., & Hakel, M. D. (1998). The substantive nature of performance variability: Predicting interindividual differences in intrapersonal performance. *Personnel Psychology*, 51, 859–901.
- Pritchard, R. D., Jones, S. D., Roth, P. L., Stuebing, K. K., & Ekeberg, S. E. (1988). Effects of group feedback, goal setting, and incentives on organizational productivity. *Journal of Applied Psychology*, 73, 337–358.
- Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: Development of a taxonomy of adaptive performance. *Journal of Applied Psychology*, 85, 612–624.
- Pulakos, E. D., Schmitt, N., Dorsey, D. W., Arad, S., Hedge, J. W., & Borman, W. C. (2002). Predicting adaptive performance: Further tests of a model of adaptability. *Human Performance*, 125, 299–323.
- Raudenbush, S. W., Bryk, A. S., Cheong, Y. F., & Congdon, R. T., Jr. (2000). *HLM5: Hierarchical linear and nonlinear modeling*. Lincolnwood, IL: Scientific Software International.
- Ree, M. J., Earles, J. A., & Teachout, M. S. (1994). Predicting job performance: Not much more than g. *Journal of Applied Psychology*, 79, 518–524.
- Smith, E. M., Ford, J. K., & Kozlowski, S. W. J. (1997). Building adaptive expertise: Implications for training design. In M. A. Quinones & A. Dudda (Eds.), *Training for 21st century technology: Applications of psychological research* (pp. 87–118). Washington, DC: American Psychological Association.
- Steiner, I. D. (1972). *Group process and productivity*. New York: Academic Press.
- Taggar, S., Hackett, R., & Saha, S. (1999). Leadership emergence in autonomous work teams: Antecedents and outcomes. *Personnel Psychology*, 52, 899–926.
- VandeWalle, D. (1997). Development and validation of a work domain

- goal orientation instrument. *Educational and Psychological Measurement*, 57, 995–1015.
- Waller, M. J. (1999). The timing of adaptive group responses to nonroutine events. *Academy of Management Journal*, 42, 127–137.
- Weingart, L. R. (1992). Impact of group goals, task component complexity, effort, and planning on group performance. *Journal of Applied Psychology*, 77, 682–693.
- Weingart, L. R., & Weldon, E. (1991). Processes that mediate the relationship between a group goal and group member performance. *Human Performance*, 4, 33–54.
- Weldon, E., Jehn, K. A., & Pradhan, P. (1991). Processes that mediate the relationship between a group goal and improved group performance. *Journal of Personality and Social Psychology*, 61, 555–569.
- Weldon, E., & Weingart, L. R. (1988). Group goals and group performance. *British Journal of Social Psychology*, 61, 307–334.
- Wonderlic & Associates. (1992). *Wonderlic Personnel Test and user's manual*. Libertyville, IL: Author.
- Wood, R. E., Bandura, A., & Bailey, T. (1990). Mechanisms governing organizational productivity in complex decision-making environments. *Organizational Behavior and Human Decision Processes*, 46, 181–201.
- Wood, R. E., & Locke, E. A. (1990). Goal setting and strategy effects on complex tasks. In B. Staw & L. L. Cummings (Eds.), *Research in organizational behavior* (Vol. 12, pp. 73–110). Greenwich, CT: JAI Press.
- Yeo, G. B., & Neal, A. (2004). A multilevel analysis of effort, practice, and performance: Effects of ability, conscientiousness, and goal orientation. *Journal of Applied Psychology*, 89, 231–247.
- Zander, A. W. (1971). *Motives and goals in groups*. New York: Academic Press.
- Zander, A. W. (1981). The origins and consequences of group goals. In L. Festinger (Ed.), *Retrospections on social psychology* (pp. 205–235). New York: Oxford University Press.

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New Editors Appointed, 2007–2012

The Publications and Communications (P&C) Board of the American Psychological Association announces the appointment of three new editors for 6-year terms beginning in 2007. As of January 1, 2006, manuscripts should be directed as follows:

- *Journal of Experimental Psychology: Learning, Memory, and Cognition* (www.apa.org/journals/xlm.html), **Randi C. Martin, PhD**, Department of Psychology, MS-25, Rice University, P.O. Box 1892, Houston, TX 77251.
- *Professional Psychology: Research and Practice* (www.apa.org/journals/pro.html), **Michael C. Roberts, PhD**, 2009 Dole Human Development Center, Clinical Child Psychology Program, Department of Applied Behavioral Science, Department of Psychology, 1000 Sunnyside Avenue, The University of Kansas, Lawrence, KS 66045.
- *Psychology, Public Policy, and Law* (www.apa.org/journals/law.html), **Steven Penrod, PhD**, John Jay College of Criminal Justice, 445 West 59th Street N2131, New York, NY 10019-1199.

Electronic manuscript submission. As of January 1, 2006, manuscripts should be submitted electronically through the journal's Manuscript Submission Portal (see the Web site listed above with each journal title).

Manuscript submission patterns make the precise date of completion of the 2006 volumes uncertain. Current editors, Michael E. J. Masson, PhD, Mary Beth Kenkel, PhD, and Jane Goodman-Delahunty, PhD, JD, respectively, will receive and consider manuscripts through December 31, 2005. Should 2006 volumes be completed before that date, manuscripts will be redirected to the new editors for consideration in 2007 volumes.

In addition, the P&C Board announces the appointment of **Thomas E. Joiner, PhD** (Department of Psychology, Florida State University, One University Way, Tallahassee, FL 32306-1270), as editor of the *Clinician's Research Digest* newsletter for 2007–2012.