CHAPTER

2

Team Learning, Development, and Adaptation

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Increasing environmental turbulence driven by technological change, the challenges of globalization, clashes of culture, and political turmoil increasingly buffet organizations and upset their routines—often unexpectedly. Such change is not merely continuous—it is metamorphic, discontinuous, and unpredictable—placing a premium on organizational adaptability as a means for organizations to survive such disruptions and even thrive on the edge of chaos. Over the last two decades, organizations have responded to this turbulence by developing networks and alliances with other organizations, flattening structures, and reorganizing work around teams to push decisions closer to the problem source, decrease response time, and increase flexibility.

Work teams

> (a) are composed of two or more individuals, (b) who exist to perform organizationally relevant tasks, (c) share one or more common goals, (d) interact socially, (e) exhibit task interdependencies (i.e., workflow, goals, outcomes), (f) maintain and manage boundaries, and (g) are embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity. (Kozlowski & Bell, 2003, p. 334)

Although teams are often viewed as a means to enable organizational adaptability (Devine, Clayton, Phillips, Dunford, & Melner, 1999; Lawler, Morhman, & Ledford, 1995), it is important to recognize that merely restructuring work around teams rather than clusters of individual jobs does not ensure that effective and adaptive teams will be created. Indeed, many efforts to organize work around teams yields "phantom" teams of individuals working in parallel that, with process loss (Steiner, 1972), actually impedes performance and flexibility; a cluster of individuals that is a team in name only. A team-based work structure makes sense when no one person can accomplish the task and information, distinctive knowledge or expertise, and effort need to be coordinated. On the other hand, we do not mean to imply that teams are purely collective and holistic entities that are somehow disconnected from or independent of the characteristics of the members that compose them. Individuals possess a range of characteristics (Pulakos, Arad, Donovan, & Plamondon, 2000) that can influence team learning and adaptation, but that is not the focus of this chapter.

The creation of an adaptive team necessitates learning the capabilities that underlie team performance, developing collaboration and coordination skills to effectively combine member resources, and adapting capabilities, coordination, and performance to meet unexpected and novel challenges (Kozlowski, Gully, Nason, & Smith, 1999). It is a process of knowledge and skill compilation among team members that is shaped by organizational system factors that characterize the context (e.g., top-down influences), by actions of the team leader (e.g., team-level factors), and by interactions among members (e.g., bottom-up emergence) as the team develops its capabilities over time. Thus, our perspective is a multilevel one that simultaneously considers individuals—the team, its embedding task, and organizational context—and the interplay among these multiple levels over time as team adaptive capabilities develop, emerge, and manifest.

Our purpose is to explore conceptually these themes centered on team learning, development, and adaptation. We note at the onset that this chapter is not a comprehensive review of the literature. Indeed, solid conceptual and empirical work on these themes are sparse relative to the vast amount of work on team effectiveness more generally, and therefore a thematic set of topics that are ripe for conceptual development and integration (Kozlowski & Bell, 2003; Kozlowski & Ilgen, 2006). We draw on an ongoing stream of theory development and research in these areas to integrate and sculpt a distinct perspective on team learning, development, and adaptation.

We begin with a discussion of the nature of emergent phenomena; that is, how team-level properties emerge from the perceptions, knowledge, feelings, actions, and interactions among individuals (Kozlowski & Klein, 2000). The factors that determine the nature of emergence are directly relevant to conceptualizing team learning in terms of emergent states (Marks, Mathieu, & Zaccaro, 2001) or developmental outcomes (e.g., collective knowledge representations, cognitive structures) and dynamic processes (e.g., learning and development). Here we would note that the literature has been far more fascinated with conceptualizing team-learning outcomes or emergent states than with the processes by which collective knowledge is acquired and crystallized. Our primary purpose in this section is to establish that qualitatively different forms of emergence related to team performance and effectiveness are driven by the organizational system context, the team task, and resulting workflow interdependencies that link members. This is key to understanding the implications for the nature of team-learning outcomes and processes.

In the next section, we briefly review outcome representations of team learning with a particular focus on cognitive or knowledge-based outcomes and also a consideration of motivational states and behavioral competencies, and how different outcomes are linked to differing forms of emergence. Because this literature has been subject to extensive reviews (e.g., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Bell, 2003; Kozlowski & Ilgen, 2006) and is covered elsewhere in this volume, in this chapter, we merely summarize, highlight, and inform.

We then turn attention to the processes underlying team learning, development, and adaptation. We first consider the "engine" for individual and team learning; that is, a psychological process of learning that underlies both individual and team learning and performance—multilevel multiple-goal regulation (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). We then address the "vehicle" for team development and adaptation; that is, developmental experience in the team context. Team compilation is a process that yields knowledge and skill outcomes at the individual and team levels and as team skills compile; exploration and experimentation by the team yields a repertoire of capabilities and response alternatives that enable team adaptability (Kozlowski et al., 1999).

Finally, we close with a brief consideration of some ways to enhance team learning, development, and adaptation. We consider how training experiences can be embedded in work systems and how team training, simulations, and other forms of "synthetic experience" can provide an infrastructure for team (and organizational) learning (Kozlowski, Chao, & Nowakowski, in press). We also consider the critical role of team leaders as shapers and developers of adaptive teams (Kozlowski, Watola, Nowakowski, Kim, & Botero, in press). Considered together, the distinct theory and research streams that we weave constitute an integrated perspective on the nature of team learning, development, and adaptation.

THE NATURE OF EMERGENCE

Our intent in this section is to sketch three fundamentals in our consideration of team learning, development, and adaptation as emergent phenomena. Emergence is a bottom-up and interactive process. It is shaped and constrained by the organizational and team task context, and it is patterned in different ways—which is to say that it can manifest in different forms. (See Kozlowski & Klein, 2000; Morgeson & Hoffman, 1999 for more detailed discussions.)

Bottom Up and Interactive

Kozlowski and Klein (2000) defined emergence as follows: "A phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon" (p. 55). Applied to team learning, there are key assumptions inherent in this definition of emergence.

First, learning is a psychological change that takes place within the person and, thus, is fundamentally an individual-level property (Kozlowski & Salas, 1997). Individuals acquire a knowledge of facts (e.g., declarative knowledge) and they link the application of facts to enabling conditions (e.g., procedural knowledge) and, with experience, develop strategic knowledge to guide prioritization and resource allocation (Anderson, 1987; Ford & Kraiger, 1995), which ultimately impact performance. However, individuals do not learn in a social vacuum, and this is especially true in team contexts that also embody task exchanges. People share and exchange information, ideas, knowledge, and insights. They do so as informal social communication, as formal aspects of workflow interdependence, and as deliberate efforts to prompt knowledge acquisition, learning, and behavior change in teammates. Thus, products of individual learning are transmitted through a variety of social psychological mechanisms, such as vicarious observation, communication, exchange, collaboration, and deliberate coaching, so that they propagate across team members and emerge as a collective phenomenon.

Second, team learning embodies aspects of both process *and* structure. The nature of the process by which learning is transmitted has critical implications for the structure of the construct that emerges at the team level. At the individual level, learning is a process of psychological change that yields knowledge and skill (structure). Team learning results from a process of emergence as individual level knowledge and skill intersect, amplify, and compile to yield team-level manifestations of collective knowledge and skill (Kozlowski et al., 1999). Hence, we will treat team learning as a phenomenon with structure and process aspects, considering each aspect in turn.

Shaped by the Context

Patterns of interaction among individuals are shaped and constrained by a variety of organizational and team characteristics. With respect to team learning, proximal linkages among members within teams are largely dictated by workflow interdependencies that yield team performance. Such linkages pattern exchanges of information, knowledge, and skills needed to "get work done." In that sense, learning is more likely to propagate along direct, frequent, and proximal linkages in the network of workflow. Exchange linkages for boundary spanners—those members connecting between teams—also provide a conduit for knowledge and learning to flow into and out of a unit. Although we view these formal work-based linkages as the primary means for patterning the emergence of team learning, we acknowledge that informal social exchanges based on friendship or propinquity (but not workflow) also play a role (Campbell, 1959; Rentsch, 1990).

For example, Fig. 2.1 illustrates a range of workflow patterns that range from simple to complex—pooled, sequential, reciprocal, and team network (Van de Ven, Delbeq, & Konig, 1976). For pooled teams, one would expect team learning, if it emerges at all, to be patterned by friendship or proximity, since there are no real workflow links among members. For sequential teams, learning would tend to propagate across adjacent links and in one direction. For reciprocal teams, propagation

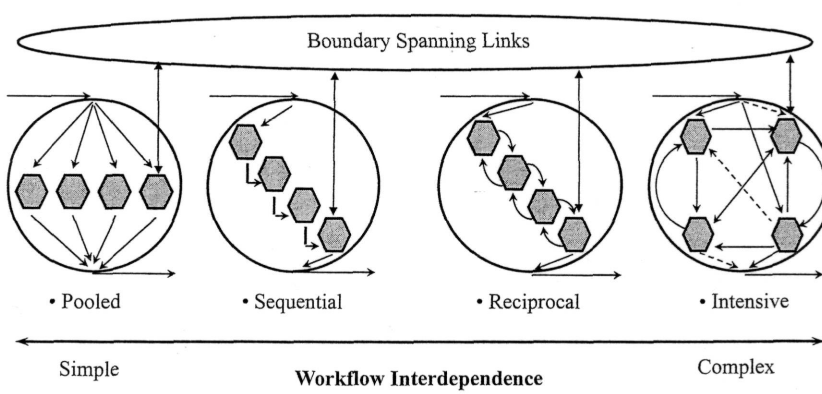

Figure 2.1 A continuum of team task workflow.

could be more uniform and bidirectional, whereas for team networks, centrality, transaction alternatives, and frequent contacts would pattern exchanges and, hence, the emergence of team learning.

Variable in Process and Form

Depending on the nature of the patterns of interaction and exchange that link members to the phenomenon of interest, emergence is not fixed but variable in form. In other words, "collective phenomena may emerge in different ways under different contextual constraints and patterns of interaction. Emergence is often equifinal, rather than universal in form" (Kozlowski & Klein, 2000, p. 59). As shown in Fig. 2.2, Kozlowski and Klein (2000) characterized two qualitatively distinct forms of emergence—composition and compilation—that anchor opposite ends of a quasi-continuum of emergence types that we can apply to our consideration of team learning.

The composition form of emergence pertains to a phenomenon that emerges via convergent processes in which the same elemental content is shared across team members. Composition captures essentially the same construct at the individual and team levels of analysis. Such a construct is structurally equivalent (e.g., is composed of the same elemental content) and functionally equivalent (e.g., performs the same role in a

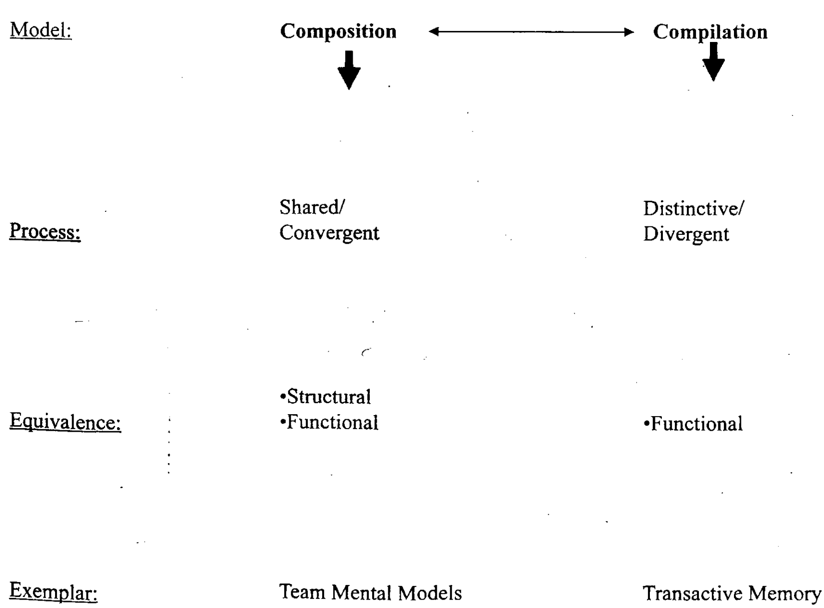

Figure 2.2 Composition and compilation forms of emergence.

model-linking constructs) at both levels of analysis (Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999).

With respect to team learning, for example, researchers have postulated that team members develop shared mental models of the team, task, equipment, and interaction pattern that enable better coordination (Cannon-Bowers, Salas, & Converse, 1993). In this conceptualization, team members share *identical knowledge*, which should enable them to anticipate one another's needs and actions and, indeed, several research studies evidence such effects (Kozlowski & Bell, 2003).

The compilation form of emergence characterizes a phenomenon that emerges via a divergent process in which different elemental content held across team members forms a patterned whole. Like the nodes and links of a network or the pieces of a puzzle, each element is unique and yet combines to form a meaningful whole. Compilation captures a construct that is functionally equivalent, but not structurally equivalent across levels (Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999).

Therefore, for example, researchers have suggested that team members may form a distributed and networked memory system—transactive memory—in which members hold distinctive knowledge and share knowledge of each member's unique expertise that enables the team to collectively access knowledge when needed (Mohammed & Dumville, 2001). Individuals do not share the same knowledge (e.g., elemental content) and therefore transactive memory is not structurally equivalent, but the team-level memory system performs a similar role in models and thus is functionally equivalent across levels. In this conceptualization, it is the configuration or pattern of distinct team-member knowledge that comprises the team-memory system.

This section has highlighted the distinction between composition and compilation processes of emergence, discussed their links to the team context (especially its workflow structure), and described their implications for the multilevel structure of the outcomes of emergence. We now turn our attention to consider in more detail the emergent states that represent outcomes of team-learning processes. We then consider team-process dynamics that give rise to collective emergent states and learning outcomes more directly.

TEAM LEARNING AS EMERGENT STATES OR OUTCOMES

In this section, we briefly review the outcome representations of team learning, with a particular focus on cognitive and knowledge-based outcomes that represent the most salient manifestations of learning as a psychological process. However, we also discuss a selective set of motivational states and behavioral capabilities that can be developed through team-learning processes and facilitate team performance and adaptability. It is important to note that our focus in this section is on the emergent outcomes that indicate that team learning has taken place, not on the learning process per se. The next section will detail the multi-level processes that underlie team learning and skill development and yield the emergent outcomes we discuss here.

We begin this section with a discussion of team climate and its role as an enabling condition for team learning. Although not an outcome of team learning per se, it is important to highlight the importance of team climate as a cognitive-contextual factor that shapes team learning through its impact on social interactions among team members. We then turn attention to several cognitive and knowledge-based emergent outcomes that have been prominently featured in prior research as indicators of team learning. Finally, we conclude with a brief discussion of a few key motivational and behavioral manifestations of team learning. As noted earlier, because this literature has been subject to many extensive reviews, our purpose is a focused discussion of these emergent states as key indicators of team learning distinct from the team-learning processes that will be examined in the next section.

Team Climate

Team climate represents cognitively based, collective perceptions of important contextual features that can influence team functioning and effectiveness (Kozlowski & Bell, 2003). One important implication of collective climates is that they characterize the "strategic imperatives" (Schneider, Wheeler, & Cox, 1992) of the organizational and team context. Kozlowski and Hults (1987), for example, showed that a shared organizational climate that emphasized the strategic imperative to stay technically current and innovative predicted individual performance, updating activity, and job attitudes among engineers in technological firms. In a recent study, Bunderson and Sutcliffe (2003) examined the relationship between management team members' climate perceptions of learning, what they referred to as team-learning orientation, and business-unit performance. They argued that, "A team learning orientation reflects a shared perception of team goals related to learning and competence development; goals that guide the extent, scope, and magnitude of learning behaviors pursued within a team" (p. 553). Their results revealed that an appropriate emphasis on learning, relative to the team's recent performance, could have positive consequences for team effectiveness. These examples highlight the role of team climate in establishing learning as a strategic imperative.

Team climates can also reflect the interpersonal context within a team, which can have important implications for the sharing and exchange of information, ideas, knowledge, and insights. Edmondson (1999), for example, examined how team learning is influenced by team psychological safety, which she defined as a shared belief that the team is safe for interpersonal risk taking. She argued that team psychological safety should facilitate learning behaviors, such as feedback seeking and experimentation, because it alleviates excessive concern about others' reactions to actions (e.g., mistakes) that have the potential for embarrassment or threat. Indeed, her results showed that team psychological safety positively influenced team-learning behaviors, which in turn influenced team performance. Smith-Jentsch, Salas, and Brannick (2001) also provided evidence that a supportive team climate is important for facilitating positive-learning behaviors. Specifically, the authors showed that trainees' transfer behavior was influenced by their perceptions of the team-transfer climate, or the degree to which a particular group of teammates accepts and expects the use of behaviors learned in a training program. It is important to note that in both of these studies the team leader had a significant influence on perceptions of the team climate.

Collective Knowledge

Conceptually, changes in a team's collective knowledge represent a direct indication that team learning has taken place. However, Kozlowski and Ilgen (2006) noted that team learning as an outcome is rarely assessed directly and instead is typically inferred from changes in team performance. For example, in a laboratory-based setting, Argote, Insko, Yovetich, and Romero (1995) examined the impact of individual turnover and task complexity on team learning. The authors found that group performance exhibited a learning curve, with output increasing significantly at a decreasing rate over six trials. Turnover and task complexity were both detrimental to group performance, with the detrimental effect increasing as groups gained experience, suggesting that turnover depleted aspects of collective knowledge. However, the problem with this approach is that many of the factors that influence team learning (e.g., turnover) are also likely to impact team performance via mechanisms other than learning. As a result, it is impossible to distinguish changes in team performance that are due to changes in a team's collective knowledge from those that result from changes in other team processes critical to team effectiveness. Thus, there is a need for research that directly measures changes in individual and team knowledge or provides some other direct evidence that learning has occurred (Ellis & Bell, 2005; Kozlowski & Ilgen, 2006).

A second important issue surrounding collective knowledge concerns the implications of different methods used to aggregate individual knowledge to create a team-level construct. A common approach is to operationalize collective knowledge as either the sum or average of individual team members' knowledge. Ellis et al. (2003), for example, assessed collective knowledge and skill by summing the effectiveness and efficiency with which individual team members prosecuted unknown tracks. Teams that were more effective and efficient on average could be inferred to have shared information or learned from one another. However, a focus on the average or sum of individual team members' knowledge does not provide insight into the distribution or pattern of content knowledge within the team. For example, the extent to which team members possess common or unique content knowledge influences the breadth of the team's information pool or the proportion of the total knowledge space covered by the team's collective knowledge (Hinsz, 1990). In addition, how a team's collective knowledge influences team performance may depend on who within the team knows what. Ellis, Bell, Ployhart, Hollenbeck, and Ilgen (2005) showed that the declarative knowledge of critical team members, or those most central to the workflow activities of the team, had a greater impact on team performance than the knowledge held by less critical team members. In the following sections, the distributional properties of collective knowledge are considered in more detail as we discuss team mental models and transactive memory. However, as Kozlowski and Ilgen (2006) noted, this raises the question as to whether team learning as a knowledge-based outcome can be meaningfully distinguished from mental models and transactive memory.

Team Mental Model

Team mental models are team members' shared, organized understanding and mental representation of knowledge about key elements of the team's task environment (Klimoski & Mohammed, 1994). Cannon-Bowers et al. (1993) outlined four content domains underlying team mental models: (a) knowledge of equipment and tools utilized by the team (equipment model); (b) understanding about the team's task, including its goals or performance requirements and the problems facing the team (task model); (c) awareness of team member characteristics, such as their knowledge, skills, preferences, and habits (member model); and (d) team members' understanding of or beliefs regarding appropriate or effective team processes (teamwork model).

Research in this area has tended to focus on the formation of common or shared team mental models as an important indicator of team development. Indeed, numerous studies have provided evidence that shared mental models are associated with team effectiveness (e.g., Marks, Mathieu, & Zaccaro, 2001; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Minionis, Zaccaro, & Perez, 1995). However, there is growing recognition that team members do not necessarily possess identical knowledge structures, but possess some shared cognition and some unique structural information that is compatible with that of other member roles (e.g., Banks & Millward, 2000; Kozlowski, Gully, Salas, & Cannon-Bowers, 1996). This conceptualization of mental models takes into consideration the distributional properties of team knowledge discussed earlier. The shared and complementary cognitions emerge from both composition and compilation processes, involving the exchange of information, ideas, knowledge, and insights within a team over time. This exchange may occur through a variety of mechanisms, including informal social interaction, shared task experiences, and formal intervention. Shared and complementary cognitions provide a foundation for essential teamwork capabilities. Specifically, this shared comprehension, often referred to as team coherence, enables a team to adapt to variations in the task environment and to maintain synchronicity without explicit directives (Kozlowski, Gully, McHugh, et al., 1996). This sharing represents an integration of task work and teamwork capabilities.

Transactive Memory

Transactive memory is a group-level shared system for encoding, storing, and retrieving information that is distributed across group members (Wegner, 1986, 1995; Wegner, Giuliano, & Hertel, 1985). The concept was introduced to explain how intimate relationships foster the development of shared memory. In essence, each partner uses the other as an external memory aid and in so doing becomes part of a larger system. In a team context, each team member maintains a registry of other members' expertise, directs new information to appropriate team members, and accesses needed information from others in the system (Mohammed & Dumville, 2001).

Transactive memory offers teams the advantage of cognitive efficiency, because individual memories become more specialized and are organized into a differentiated collective memory. The knowledge specialization that develops in a transactive memory system should reduce the cognitive load on individuals, expand the pool of collective expertise, and decrease redundancy of effort (Hollingshead, 1998a, 1998b). A study by Austin (2003) identified the specialization of knowledge and accuracy of knowledge identification as two important dimensions of transactive memory that relate to team effectiveness. However, there are limits to the size of such a distributed memory system and errors can occur as individuals update and retrieve information in the system (Wegner, 1986; Pearsall, Ellis, & Bell, 2006). Further, there are time lags involved in acquiring needed information from the system, which can be detrimental to team effectiveness in time-critical situations (Kozlowski & Bell, 2003).

Nonetheless, the emergence of transactive memory systems is an important manifestation of team-learning processes. Transactive memory systems develop as a team gains experience and members communicate and update information each has about the areas of others' knowledge. Liang, Moreland, and Argote (1995), for example, compared the performance of groups whose members were trained individually to that of groups whose members trained together. Groups whose members were trained together outperformed groups whose members were trained individually, presumably due to the operation of a transactive memory system. A subsequent study by Moreland, Argote, and Krishnan (1996) showed that subjects who were trained in one group and performed in another exhibited inferior performance to subjects who trained and performed in the same group. This finding suggests that it is the experience of working with particular group members that develops transactive memory systems (Argote et al., 2001). Some work also suggests that face-to-face interaction is important for the emergence of transactive memory and that computer-mediated communication presents barriers (Hollingshead, 1998b; Lewis, 2003).

Behavioral Capabilities and Motivational States

In addition to the cognitive and knowledge-based outcomes just discussed, changes in a team's behavioral capabilities or motivational states can indicate that learning has taken place. In this section, we provide a focused examination of how team learning may manifest in several noncognitive, team-level emergent outcomes.

Prior research has identified three key behavioral capabilities that influence team effectiveness: (a) coordination, (b) cooperation, and (c) communication (Kozlowski & Bell, 2003). Coordination and cooperation are related in that both focus on the interdependence of team members' activities, although coordination possesses a temporal component that cooperation does not. Similarly, communication is often viewed as a means of enabling coordination and cooperation. The emergence of these behavioral capabilities can be directly linked to the intersection and integration of team members' knowledge and skills. Evidence suggests, for example, that teams that share and exchange their knowledge and information will be better equipped to coordinate their actions and be "in sync." Mathieu et al. (2000) examined the influence of shared mental models on team process and performance. In the study, the team process measure consisted of three dimensions: (a) strategy formation and coordination, (b) cooperation, and (c) communication. Their results indicated that the convergence, or sharedness, of team members' mental models was positively related to team process. Further, they found that both task and team mental models had unique effects on team process. In a study using a tank-battle simulation, Marks et al. (2000) also found a significant and positive relationship between the similarity of team members' mental models and the quality of team communication processes. As noted earlier, transactive memory systems can also enhance team process and performance by promoting specialization and reducing redundancy of effort (Hollingshead, 1998b).

Given that these behavioral capabilities have been positively linked to team performance (e.g., Guastello & Guastello, 1998; Stout, Salas, & Carson, 1994), their emergence is likely to also be accompanied by an increase in team efficacy. That is, the development of shared cognitions and coordinated action patterns should facilitate team performance and goal progress. A reduction in goal-performance discrepancies should increase the shared belief in the team's collective capability to organize and execute courses of action required to produce given levels of attainment. This pattern would be consistent with the notion that just as enactive mastery contributes to individual self-efficacy, teams who experience performance successes and master difficult challenges should experience higher levels of efficacy (Bandura, 1997; Kozlowski et al., 1999). The challenge, however, is linking changes in team efficacy directly to team learning and not simply spurious improvements in team performance. This necessitates a closer examination of the self-regulatory processes that underlie team learning, which we address in the next section.

TEAM-LEARNING PROCESSES AND ADAPTATION

The prior section addressed the emergent manifestations of team learning; the collective knowledge, motivational states, and behavioral capabilities that indicate learning has occurred. Here we consider the team *processes* underlying learning and skill development that occur over time to yield collective-learning outcomes.

Basic Assumptions

There are three central points that shape our perspective on team learning. First, it is axiomatic that learning, as a psychological process, occurs within the individual. Second, although learning is fundamentally an individual-level phenomenon, team learning occurs in a task and social context that shapes what is learned and how it is learned. Third, team learning is a process that unfolds dynamically through repeated interactions and engagements over time, thereby yielding emergent outcomes signaling that learning has occurred. Thus, key to our conceptualization of team learning is to (a) first understand individual learning processes in the context of a team task *and* how individual leaning processes yield parallel team-learning processes, and (b) then to understand how individual knowledge, skills, and other capabilities compile and emerge at the team level over time.

We describe the first aspect of this conceptualization as *multiple goal, multilevel regulation,* which is based on basic psychological theories addressing the self-regulation of learning, motivation, and performance and on the principles of multilevel theory (DeShon et al., 2004). The multiple-goal, multilevel regulatory process constitutes the engine of team learning.

We describe the second aspect of this conceptualization as *team compilation,* which is based on theories of team development and on the principles of multilevel theory (Kozlowski et al., 1999). Team compilation processes capture qualitatively distinct team-member capabilities as they develop over time and emerge across levels—individual, dyadic, and team—as collective capabilities. Team compilation constitutes the vehicle for team development and adaptation.

Multiple-Goal, Multilevel Regulatory Process

Models of self-regulation reference goals as mechanisms for directing attention and effort, and strategies as ways to direct the process of goal striving. Progress toward goal accomplishment is monitored, discrepancies revealed via feedback are diagnosed, and goals and strategies are revised in an iterative process directed toward performance improvement and goal accomplishment. Over time, this process of goal striving accounts for individual learning, skill acquisition, and performance (Bandura, 1991; Locke & Latham, 1990). This general model has amassed considerable support in the literature (Karoly, 1993).

Moreover, theorists have asserted that the process of self-regulation can be extended to the team level to account for team learning, skill acquisition, and performance (Kozlowski, Gully, McHugh, et al., 1996; Kozlowski et al., 1999; Kozlowski, Gully, Salas, et al., 1996; Zaccaro, Rittman, & Marks, 2001). In support of this assertion, recent research has developed and validated a multiple-goal, multilevel model of individual and team regulation (DeShon et al., 2004).

Although most research on self-regulation has focused on individuals striving to achieve a single goal, being on a team means that individual members have to regulate their cognitive, motivational, and behavioral resources around multiple goals, both individual and team. Although theorists have asserted that the process of self-regulation can be extended to the team level to account for team learning, skill acquisition, and performance, the process of how individuals dynamically allocate their resources around multiple goals has been a research focus. Moreover, the fact that individuals allocate attention and effort around multiple goals in the team context means that regulatory processes in teams are multilevel. Yet, most research about team learning and performance either focuses only on the individual level, ignoring the nesting of individuals within the team context, or on the team level as a collective, ignoring the distinctive contributions of individuals to the team.

The conceptualization developed by DeShon et al. (2004) treated team regulation, learning, and performance as parallel, multilevel phenomena. They considered the team task as embodying a discretionary structure (Steiner, 1972) consistent with the most general type of team task in which team members have latitude in terms of *how* and *how much* of their personal resources they allocate to accomplish team performance. This team-task structure requires team members not only to strive to achieve their own goals, but also to coordinate effort and provide assistance to other team members to accomplish related but distinct team objectives. Individual team members have to make resource-allocation decisions that balance individual goal striving while also contributing to the team by coordinating collective effort or backing up a teammate.

DeShon et al. (2004) first conceptualized the influence of these multiple goals— individual and team—on the goal-feedback loops underlying the regulation of individual attention and the allocation of behavioral resources. Fig. 2.3 illustrates a heuristic model of the interdependent goal-feedback loops that underlie individual and team-resource allocation. In this heuristic, the distinct individual and team goals and their associated feedback loops vie for behavioral control, and both goal-feedback loops cannot be influenced simultaneously; individual and team performance are distinct resource allocations. The individual goal-feedback loop monitors discrepancies between current performance and individual goals and activates behavioral outputs to reduce the discrepancy. The team-feedback loop operates on the individual's team goals to activate behavioral outputs to reduce team-level discrepancies. Because individual and team performance is distinct, the behavioral output from each of the feedback loops affects the performance levels being regulated by the other feedback loop. Minimizing discrepancies on one loop will typically yield larger discrepancies on the other loop. In addition, the nature of the situation or surrounding environmental context and changes in the context may sensitize individuals to one loop or the other by increasing the salience of discrepancies on that loop. In other words, situational factors may bias resource allocation toward either the team or individual level.

Next, the dynamic self-regulatory implications of the multiple-goal resource allocation model were extrapolated over time to develop a multilevel model that captured regulatory processes at both the individual and team levels. The multilevel regulation model is shown in Fig. 2.4. The essential characteristics required to validate a multilevel

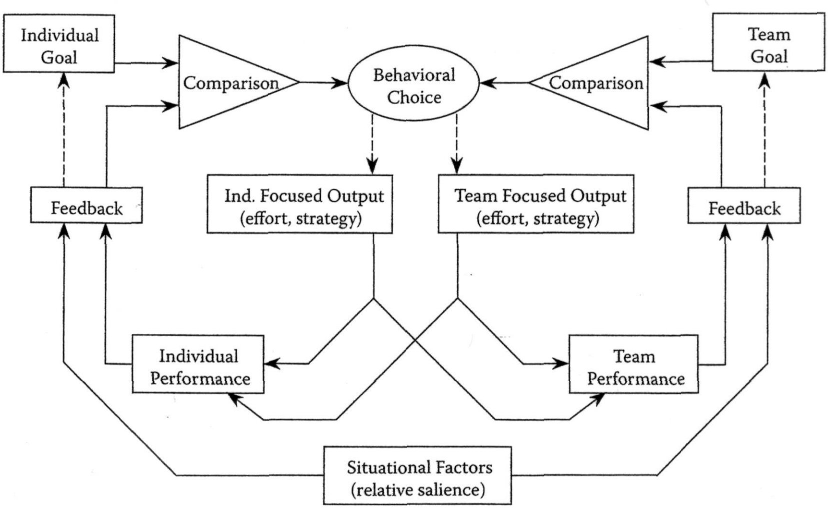

Figure 2.3 Multiple goal regulation: Individual and team goal-feedback loops.

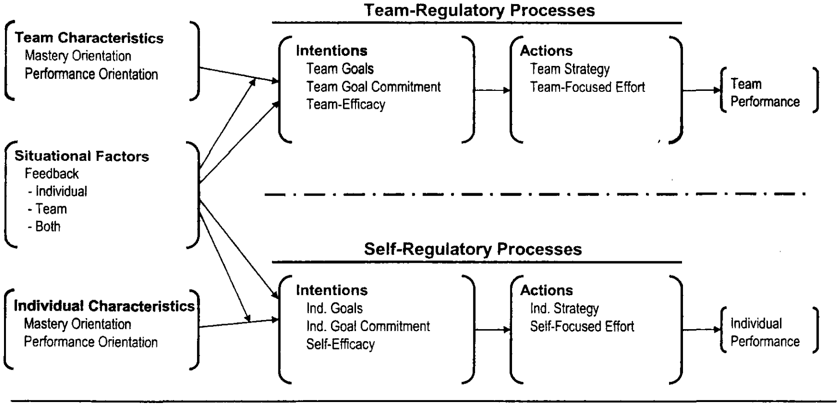

Figure 2.4 A multilevel homology of individual and team regulatory processes.

model are (a) that team-level constructs, conceptually parallel to those at the individual level, satisfy statistical criteria to support composition or aggregation to the team level, and (b) that the linkages among parallel constructs at both levels demonstrate functional equivalence or configural invariance (Kozlowski & Klein, 2000). In an experimental design that examined 237 trainees organized into 37 teams of three, DeShon et al. (2004) provided empirical support for the multiple-goal (Fig. 2.3), multilevel (Fig. 2.4) models. Of particular importance, the relative salience of either the individual or team goal-feedback loops was the primary factor driving individual resource allocations and, ultimately, manifestations of team learning and performance. In essence, the research demonstrated that the key regulatory processes responsible for individual resource allocation, skill acquisition, and performance also substantially hold at the team level. This provides validity evidence for the multiple-goal, multilevel-regulation model as a basic process model that accounts for team learning.

Team Compilation

Whereas multiple-goal, multilevel regulation constitutes the psychological engine of team learning, team compilation constitutes the emergent process by which such learning manifests as collective capabilities that enable teams to adapt to the unexpected. Kozlowski and colleagues (1999) applied a process perspective to develop a normative model of team compilation with self-regulatory underpinnings that integrates learning, team development, and team performance perspectives with the principles of multilevel theory. Their theoretical framework is characterized by three key conceptual features that center on (a) episodic task cycles, (b) temporal development with attention to distinct learning content and outcomes as development progresses, and (c) transitions in the focal level of learning and development.

First, task dynamics are viewed in terms of cyclical task episodes. Task cycles capture the effects of multiple task episodes and the individual and team regulatory processes discussed previously that energize individual and team learning. Variations in task episodes or cycles prompt individual regulatory processes, providing experiences for learning and skill acquisition (Kozlowski, Gully, McHugh, et al., 1996; Kozlowski, Gully, Salas, et al., 1996; Marks et al., 2001). With repeated experiences, skill acquisition in the team context begins to shift from individual regulation to multiple-goal, multilevel regulation (DeShon et al., 2004). This enables the compilation process.

Second, developmental processes and transitions capture the compilation of knowledge and skills. This is partly modeled on the way individual expertise is acquired. As novices make the transition to experts, they progress through a series of learning phases during which their knowledge and skills compile into qualitatively different forms—declarative, to procedural, to strategic (Anderson, 1987; Ford & Kraiger, 1995). Similarly, team capabilities improve developmentally, thereby prompting transition to more advanced phases of skill acquisition that entail distinct learning content and outcomes.

Third, team compilation is viewed as an emergent multilevel phenomenon. In a team context, knowledge and skill compilation have emergent manifestations at multiple levels of analysis. Knowledge, skills, and performance capabilities compile across focal levels from an individual self-focus to a focus on dyadic workflow exchanges to a focus on developing an adaptive team network. Team members transition from a focus on the self (e.g., What do I need to do to perform my task?) to a focus on those teammates with whom they have a direct link (e.g., With whom do I exchange inputs and outputs?) to focus on the team as an entity (e.g., How do we coordinate and adapt?). Teams become self-regulating and adaptive entities.

As shown in Fig. 2.5, the theory postulates four phase transitions as a set of individual team members develop into an adaptive team across content domains and levels. In the first phase, team formation, team members are socialized to the team as an entity, yielding outcomes of interpersonal knowledge and team orientation, providing a foundation for shared norms, goals, and climate perceptions. As they transition to the next phase, task compilation, team members acquire task knowledge, yielding outcomes of task mastery and self-regulation skills. The focal level transitions to dyads in the fourth phase, role compilation, as team members identify their role sets, negotiate role exchanges, and develop routines to guide task exchanges. In the last phase, team compilation, the focal-level transitions to team members develop a reconfigurable network of role linkages that enable incremental improvement

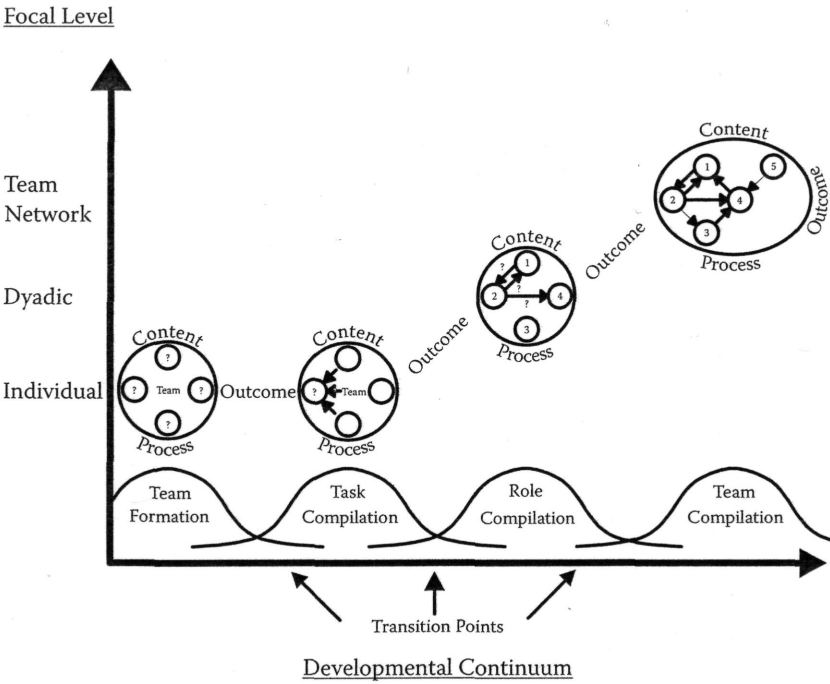

Figure 2.5 A process model of team compilation.

for routine tasks and capabilities for adaptation to novel and unexpected demands. Although there are no direct tests of the theory, it is synthesized from a diverse literature. Moreover, DeShon, Kozlowski, Schmidt, Wiechmann, and Milner (2001) provided preliminary support for the basic proposition that developmental shifts in focal level from individual to team contribute to team performance adaptability.

ENHANCING TEAM LEARNING, DEVELOPMENT, AND ADAPTATION

Our conceptualization of team learning as an emergent multilevel regulatory process means that interventions designed to influence and improve team learning should target the nature, focus, and quality of regulation at the individual and team levels of analysis. Here we highlight two primary types of interventions—training systems and team leadership—with high potential for enhancing team-learning processes and outcomes. Although theory and research in these two areas of theory and research are largely distinct in the literature, we believe that they have high potential for integration and will be increasingly entwined in the future as organizations focus on building an infrastructure to promote collective learning (Kozlowski, Chao et al., in press).

Training Systems

Many different training techniques can be used to deliver training to teams and to team members. Indeed, because both the delivery of individual knowledge and skills (e.g., task work), as well as the team skills that enable coordination (e.g., teamwork) are required, any number of techniques are potentially relevant. We do not intend to provide an exhaustive treatment. Readers are directed to Salas and Cannon-Bowers (1997) for a more complete summary of methods and approaches for training team members and teams.

Rather, consistent with our conceptualization of team learning as a process, we focus on techniques that have the potential to influence the nature, focus, and quality of self- and team regulation. Moreover, many scholars have suggested that teams learn best by doing (Dyer, 1984); that is, through practice and guided experiences that emulate their task and its performance setting. Thus, we focus on techniques that selectively stimulate regulatory processes and allow training to be delivered through computer simulations and/or are embedded in workplace technology systems to create synthetic learning environments (Cannon-Bowers & Bowers, in press; Kozlowski, Toney et al., 2001).

Note that although the *content* for knowledge and skill acquisition differs for individual (e.g., task work) and team (e.g., teamwork) training, the *principles* for designing an instructional experience (Cannon-Bowers & Bowers, in press) and stimulating the underlying regulatory processes (Kozlowski, Toney, et al., 2001) are largely the same. It is the same whether the training is delivered under simulated conditions or is embedded in a technology system that augments learning during real-time task performance. Thus, we do not make specific distinctions between individual and team training or embedded and synthetic training with regard to selectively stimulating regulation and sequencing instructional phases.

Cannon-Bowers and Bowers (in press) defined *Synthetic Learning Environments* (SLEs) as "... a variety of technology-based training media or approaches that have as an essential feature the ability to augment, replace, create and/or manage a learner's actual experience with the world by providing realistic content and embedded instructional features" .... [that include] simulations, games and virtual worlds" (p. 2). Drawing on an integrative review of instructional design by Sugure and Clark (2000), they proposed six instructional phases that need to be addressed in the design of an SLE: (a) articulate and clarify the instructional goals and supports for motivation and learning strategies, (b) instill declarative knowledge (knowledge of task facts), (c) create practice experiences to translated declarative knowledge to procedural skill, (d) monitor trainee progress, (e) diagnose trainee deficiencies, and (f) present appropriate feedback, adapt training, or give remediation. They then reviewed the literature and identified interventions that can be used to accomplish each of these instructional objectives for SLE design.

The theoretical model developed by Kozlowski, Toney et al. (2001) to guide the design of embedded and simulation-based training integrates these instructional objectives (Cannon-Bowers & Bowers, in press; Sugure & Clark, 2000) within the process of learning and adaptation. The model developed by Kozlowski and colleagues uses self-regulation as its core theoretical process. The basic logic of their design approach is that a training strategy is constructed from a combination of distinct training components—training design, information provision, and trainee orientation—designed to actively influence the self-regulation process. Training design refers to the nature of the experiences, such as practice experiences, simulation scenarios, or experiential exercises that are emulated by a simulation or embedded in a work technology system. This incorporates factors such as practice variability (e.g., the extent to which the goals, problem, or scenario complexity varies or is fixed), sequencing (e.g., the extent to which the goals, problem, or scenario complexity scaffolds skill acquisition), and scenario complexity (e.g., difficulty, interconnections, and dynamics). *Information provision* refers to the way that feedback information can be presented to shape how trainees interpret and calibrate their prior progress and whether it guides them to influence future self-regulatory focus, effort, and strategies. *Trainee orientation* references motivational frames, such as goal orientation, that affect the way the trainee perceives the training experience as one of mastering the task for its own sake or performing well relative to others (Dweck, 1986).

Experimental research has been supportive of the utility of this approach for constructing interventions that enhance self-regulatory processes during simulation-based training, with subsequent effects on learning (e.g., basic and strategic knowledge), performance (e.g., basic and strategic performance), and performance adaptation (see Bell & Kozlowski, in press, for a review summary). Although this work has been conducted at the individual level, given the findings of DeShon et al. (2004), its use of regulatory processes as the core theoretical process suggests that the design logic can be extend across multiple levels to encompass the team level. Indeed, work by Chen, Thomas, and Wallace (2005) examined how multilevel regulatory processes (individual and team) accounted for the relationship between outcomes at the end of training and subsequent performance adaptation during transfer. Their work represents an integration and extension of this regulation-based perspective on team learning and training, and further supports its applicability and promise.

The key distinction for team training is the shift from a primary focus on individual task proficiency to a focus on competencies that enable members to combine their expertise, information, resources, and effort to collectively accomplish the team task. For instance, team self-correction training has been identified as one strategy for fostering the development of team mental models (Blickensderfer, Cannon-Bowers, & Salas, 1997). By training team members on skills such as monitoring one another and exchanging feedback, team self-correction training leverages key elements of information provision to influence collective interpretation of the team's prior progress and planning for the future. Cross-training is another strategy that has received significant attention as a means of enhancing team processes. Marks, Sabella, Burke, and Zaccaro (2002), for example, found that positional modeling, which entails both verbal discussion and observation of different team members' roles, enhanced the development of shared team-interaction models. A somewhat different strategy for enhancing team process is teamwork-skills training, which focuses on providing individuals with the generic teamwork skills necessary across a variety of team and task settings (Salas & Cannon-Bowers, 1997). A recent study by Ellis et al. (2005) showed that generic teamwork-skills training enhanced individuals' declarative knowledge of teamwork competencies. Further, teams composed of trained members evidenced higher levels of planning and task coordination, collaborative problem solving, and communication.

A recent meta-analysis by Klein et al. (2005) of the effectiveness of team training techniques provided insights into techniques that evidence effectiveness for improving team processes, performance, and affective reactions. The team-training strategies with a sufficient number of studies to examine included cross-training; variants of team adaptation, coordination, or crew-resource-management (CRM) training; and different types of simulation-based training. The results provided evidence for training effectiveness for each of these strategies. Cross-training, in which team members get trained on other members' roles, evidenced an overall correlation of .47 with the outcomes (the 95% confidence interval ranged from .38 to .56) based on 6 studies and 13 effect sizes. Simulation-based training evidenced an overall correlation of .45 with the outcomes (the 95% confidence interval ranged from .38 to .50) based on 37 studies and 81 effect sizes. And, team adaptation, coordination, and CRM training had an overall correlation of .60 (the 95% confidence interval ranged from .48 to .70) based on 16 studies and 30 effect sizes. The bottom line: team-learning processes and outcomes can be enhanced through the use of team-training strategies. Moreover, the increasing sophistication of team simulations and other SLE's and the capability to embed training capabilities into work systems provides a means for organizations to develop an infrastructure to prompt, guide, and support the individual and team learning that form the basis for organizational learning systems (Kozlowski, Chao et al., in press).

Team Leadership

Most mainstream theories of leadership are intended to be universal, focusing on leadership across all contexts and levels of the organization (Kozlowski, Watola et al., in press). Functional-leadership theory (McGrath, 1962) has centered on level of the team and individuals embedded in teams. According to McGrath (1962), the leader is responsible for ensuring that all necessary functions for team-task accomplishment and the maintenance of member interpersonal and social relationships are accomplished. The leader does this by monitoring the team and taking necessary action to deal with internal or external challenges that might interfere with the task or social functions. A number of other scholars have contributed to the development of this perspective over the intervening years (e.g., Fleishman et al., 1991; Hackman & Walton, 1986; Komaki, Desselles, & Bowman, 1989; Lord, 1977; Zaccaro et al., 2001).

More recent work in this tradition has centered on leader functions that underlie team learning and development. For example, Edmondson (1999) viewed the primary role of the leader in promoting team learning as one of establishing a shared group climate for safety, so members could experiment, take risks, and stretch their skills. Drawing on Fleishman et al. (1991), Zaccaro et al. (2001) provided a broad framework encompassing four superordinate and thirteen subordinate leadership functions. Of interest is their attention to the leader's role in team learning by prompting the development of team-mental models, collective information processing, and team metacognitive processes. Hackman and Wageman (2005) proposed a model of team coaching in which they posit that leaders can positively influence team learning and development by providing motivational functions (getting familiar) early in a team's work cycle, consultative functions (task strategies) at the mid-point of its work, and educational functions (reflection) at the end of a meaningful *task* episode or piece of work. Note that this last aspect of the theory evidences an apparent temporal discontinuity because it references a work episode, which cycles more rapidly relative to the first two phases that reference development along a slower linear progression.

One line of theorizing in this tradition is designed to directly integrate with the perspective of team learning and development as a multilevel emergent regulatory process that we have highlighted throughout this chapter. A series of theoretical frameworks by Kozlowski, Gully, McHugh, et al. (1996), Kozlowski, Gully, Salas, et al. (1996), and Kozlowski, Watola et al. (in press) integrated functional leadership (McGrath, 1962), regulatory processes (Karoly, 1993), team development (Tuckman, 1965), and multilevel theory (Rousseau, 1985) to develop a normative theory of team leadership. Fig. 2.6 illustrates primary aspects of the theory. A key aspect of its conceptual approach is that it specifies dynamic environmental, developmental, and task-

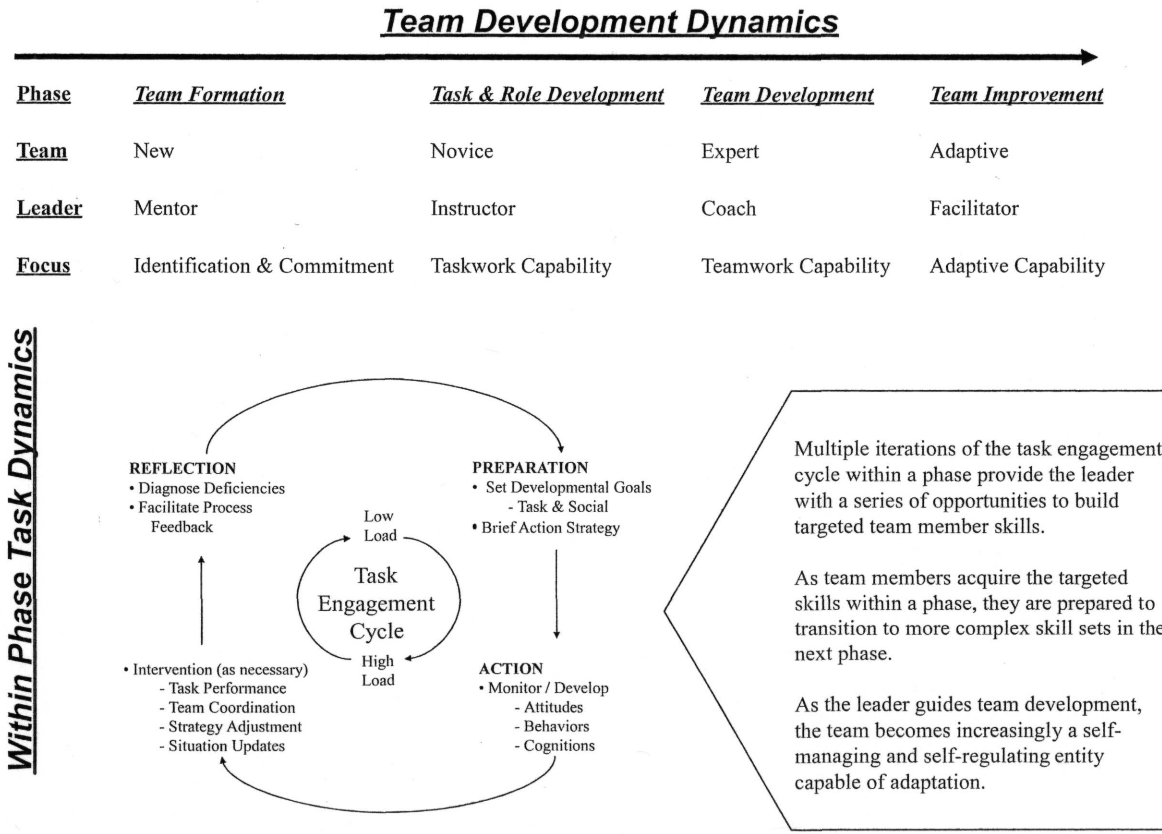

Figure 2.6 Task engagement cycles and developmental phase transitions.

episode contingencies that should influence that application of leader functions. Team tasks are viewed as linked to an embedding environment or broader organizational system that is a source of team-task demands, which necessitate appropriate team processes for resolution, which then yield team performance outputs that cycle back to the context in an adaptive loop. The overarching role of the leader is to guide and shape the acquisition of member capabilities, so the team can eventually regulate this systemic transformation process. One primary leader function is task based or instructional. The leader has to manage dynamic contingencies that arise from the environment (variations in environmentally driven task complexity) and link task variations to the regulatory processes of setting learning goals, monitoring progress, and intervening to aid the team as needed, diagnosing performance deficiencies, and guiding process feedback. This instructional function stimulates team-member regulation and the acquisition targeted knowledge and skills. A second primary leader function is developmental. As team members compile basic knowledge and skills, the leader prompts transitions to focus the team on acquiring progressively more advanced skills and capabilities (Kozlowski et al., 1999). Over time, this dynamic leadership process of shaping regulation and transitioning the focus of skill development is expected to yield team-level regulation and adaptive teams (Kozlowski, Watola et al., in press). Although there are no direct evaluations of the efficacy of this theory, research examining key aspects of the model including the regulatory process engine (Chen et al., 2005; DeShon et al., 2004) and the developmental shift in level (DeShon et al., 2001) have been supportive. The bottom line is that team leaders are key agents for creating learning experiences (e.g., using SLE's, creating exercises, harnessing ongoing tasks) for prompting, guiding, and shaping team learning and the development of adaptive teams.

CONCLUSION

The increasing push toward team-based work structures in organizations and the need to build human capital to respond to unexpected challenges, make salient the importance of the themes we explored in this chapter: team learning, development, and adaptation. Although the amount of theory and research devoted to these topics is quite small in relation to the vast literature on team effectiveness, these thematic areas are garnering increased attention from organizational scholars who are generating new, diverse, and innovative approaches (Kozlowski & Bell, 2003; Kozlowski & Ilgen, 2006). And, while diversity is a good thing, we also think that an integrated perspective can be useful for guiding productive lines of research.

Our purpose was to selectively focus on several streams of theory and research embedded in our themes and to weave them together into a perspective that integrates team learning, development, and adaptation.

We would not argue that the framework we offer is the only way to conceptualize team learning; other chapters in this volume offer alternative perspectives. However, we do believe that the theoretical breadth and interlocking features of our conceptualization—which encompasses self-regulation and multiple goal loops as the core psychological processes underlying learning, multilevel theory to characterize the compilation of emergent team-learning outcomes, and team leadership and training as levers that can be used to guide, shape, and enhance the development of team adaptability—provides our perspective with unique synergies, conceptual strengths, and research directions.

We have shown that early treatments of team learning as a simple aggregate of individual knowledge or performance, while a reasonable point of departure, are an inadequate foundation for the conceptualization of team learning. Such treatments neglect the interface between individual learning and team learning, and treat team learning as an outcome rather than a psychological process with effects at multiple levels. Although there is growing conceptual sophistication regarding distinctions between team-learning processes, emergent states as learning outcomes, and the compilation of team regulation, performance, and adaptive capabilities, more multilevel (e.g., individual and team) and temporally dynamic (e.g., task episodes and skill progression) research is needed. We have provided a theoretical integration and foundation, initial research findings, and a map to guide further research. We believe that team-learning processes can be shaped and show great promise for widespread application, and we hope the perspective we offer will help stimulate that effort.

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