

# **A Multilevel Approach to Theory and Research in Organizations**

## **Contextual, Temporal, and Emergent Processes**

Steve W. J. Kozlowski  
Katherine J. Klein

Organizations are multilevel systems. This axiom—the foundation of organizational systems theory—is reflected in the earliest examples of organizational theory, including the Hawthorne Studies (Roethlisberger & Dickson, 1939), Homans's theory of groups (1950), Lewin's field theory (1951), sociotechnical systems theory (Emery & Trist, 1960), Likert's theory of organizational effectiveness (1961), Thompson's (1967) theory of organizational rationality, and Katz and Kahn's (1966) social organizational theory, to name but a few. Further, this axiom continues to provide a foundation for virtually all contemporary theories of organizational behavior. Yet, despite the historical tradition and contemporary relevance of organizational systems theory, its influence is merely metaphorical. The system is sliced into organization, group, and individual levels, each level the province of different disciplines, theories, and approaches. The organization may be an integrated system, but organizational science is not.

There are signs that this is beginning to change, that we are moving toward the development of an integrated conceptual and

methodological paradigm for organizational science. We have witnessed the evolution, over the last two decades, of multilevel frameworks that have well-developed conceptual foundations and associated analytic methodologies. Organizational science is moving toward the development of a paradigm that can bridge the micro-macro gap in theory and research. We are witnessing the maturation of the multilevel paradigm in organizational science.<sup>1</sup>

As with all maturation, however, the process has not proceeded without pain. The roots of the multilevel perspective are spread across different disciplines and literatures, obscured by the barriers of jargon, and confused by competing theoretical frameworks and analytic systems. Although there are some explicit efforts to specify general multilevel frameworks for organizational science (e.g., Dansereau, Alutto, & Yammarino, 1984; House, Rousseau, & Thomas-Hunt, 1995; Klein, Dansereau, & Hall, 1994; Roberts, Hulin, & Rousseau, 1978; Rousseau, 1985), real and apparent differences among the frameworks have created the impression of little common ground (e.g., George & James, 1994; Klein, Dansereau, & Hall, 1995). Further, the best way to evaluate multilevel theories (e.g., George & James, 1993; Yammarino & Markham, 1992) and establish emergent constructs (e.g., James, Demaree, & Wolf, 1993; Kozlowski & Hattrup, 1992; Schmidt & Hunter, 1989) is much contested. No single source exists to cut across these differences and to guide the interested researcher in the application of multilevel concepts. This contributes to confusion and limits the development of multilevel theories. Accordingly, a review of the current literature is likely to leave those who are tempted to test multilevel theories intrigued yet confused—inspired yet wary.

Our goal in this chapter is to help resolve this confusion by synthesizing and extending prior work on the development of multilevel theory and research for organizations. The chapter is organized into three sections. In the first section, we review the theoretical roots of the multilevel perspective as it relates to theory building and research in organizations. The epistemological foundation and several basic assumptions for the levels perspective are rooted in general systems theory (von Bertalanffy, 1968) and related variants. Early and enduring applications of the levels perspective to research on organizational characteristics and organizational cli-

mate had a formative impact on the development of the levels perspective and continues to exert considerable influence.

In the second section, we clarify, synthesize, and extend basic principles to guide multilevel theory development and to facilitate empirical research. We first provide principles to guide the development of multilevel theory. We discuss theoretical issues pertaining to the origin and direction of phenomena across levels, unit and entity specification, time, and factors affecting the degree of coupling or linkage of phenomena across levels. With this theoretical foundation in place, we next explain and illustrate how to specify and operationalize multilevel models. Critical issues focus on establishing an alignment among levels of theory, constructs, and measures. We also specify different types of levels models, examine implications for research sampling, and provide an overview of data-analysis issues.

In the third section, we extend multilevel organizational theory by drawing particular attention to relatively neglected *bottom-up* processes. Many organizational theories are implicitly or explicitly *top-down*, addressing the influence of macro levels (for example, organization or group characteristics) on micro levels (for example, individuals). Such models focus on contextual factors at higher levels that constrain and influence lower-level phenomena. Bottom-up models describe phenomena that have their theoretical origin at a lower level but have emergent properties at higher levels (for example, psychological and organizational climate, individual and team effectiveness, individual and organizational learning). Models of emergence have been largely restricted to isomorphic composition processes, which has limited the development of bottom-up multilevel theory and research. We elaborate discontinuous, configural compilation of alternative and describe how they allow the conceptualization of alternative manifestations of emergence. We use this perspective to extend extant models of emergence. We develop a *typology of emergence* to illustrate and explain several alternative models that range from isomorphic composition to discontinuous compilation. We are hopeful that these alternative models of emergence will stimulate and guide research on these central but neglected multilevel phenomena.

## Foundations for Multilevel Theory in Organizations

### Conceptual Underpinnings

#### *General Systems Theory*

General systems theory (GST) has been among the more dominant intellectual perspectives of the twentieth century and has been shaped by many contributors (e.g., Ashby, 1952; Boulding, 1956; Miller, 1978; von Bertalanffy, 1972). Systems concepts originate in the "holistic" Aristotelian worldview that the whole is greater than the sum of its parts, in contrast with "normal" science, which tends to be insular and reductionistic. The central goal of GST is to establish principles that generalize across phenomena and disciplines—an ambitious effort that is aimed at nothing less than promoting the unity of science.

Systems principles are manifest as analogies or *logical homologies*. Logical homologies represent identical concepts (that is, *isomorphism*), and parallel processes linking different concepts (that is, *homology*), that generalize to very different systems phenomena (von Bertalanffy, 1972). For example, it is noted that open systems counteract the second law of thermodynamics—entropy—by importing energy and information from the external environment, and transforming it, to maintain homeostasis. Feedback and servo-mechanisms are the basis for the purposive responses of cybernetic systems. Organizational systems are proposed to have analogous structures and processes (e.g., Katz & Kahn, 1966; Miller, 1978).

Whether one takes a more macro (Parsons, 1956, 1960) or micro (Allport, 1954) perspective, the influence of GST on organizational science has been pervasive. Unfortunately, however, that influence has been primarily metaphorical. The bureaucratic-closed systems-machine metaphor is contrasted with a contingent-open systems-living organism metaphor. Although metaphor has important value—virtually all formal theory is rooted in underlying metaphor (Morgan, 1983)—lack of specificity, formal identity, and precise definition can yield truisms that mislead and fail the test of science (Pinder & Bourgeois, 1982; Bourgeois & Pinder, 1983). GST has exhibited heuristic value but has contributed relatively little to the development of *testable principles* in the organi-

zational sciences (Roberts et al., 1978). It is to this latter concern that the multilevel perspective is directed.

As social systems, organizations are qualitatively distinct from living cells and other concrete physical systems. The goal of the multilevel perspective is not to identify principles that generalize to other types of systems. Although laudable, such an effort must often of necessity gloss over differences between qualitatively different systems in order to maintain homology across systems (compare Miller, 1978). *The primary goal of the multilevel perspective in organizational science is to identify principles that enable a more integrated understanding of phenomena that unfold across levels in organizations.*

#### *Macro and Micro Perspectives*

Fundamental to the levels perspective is the recognition that micro phenomena are embedded in macro contexts and that macro phenomena often emerge through the interaction and dynamics of lower-level elements. Organizational scholars, however, have tended to emphasize either a micro or a macro perspective. The macro perspective is rooted in its sociological origins. It assumes that there are substantial regularities in social behavior that transcend the apparent differences among social actors. Given a particular set of situational constraints and demographics, people will behave similarly. Therefore, it is possible to focus on aggregate or collective responses and to ignore individual variation. In contrast, the micro perspective is rooted in psychological origins. It assumes that there are variations in individual behavior, and that a focus on aggregates will mask important individual differences that are meaningful in their own right. Its focus is on variations among individual characteristics that affect individual reactions.

Neither single-level perspective can adequately account for organizational behavior. The macro perspective neglects the means by which individual behavior, perceptions, affect, and interactions give rise to higher-level phenomena. There is a danger of superficiality and triviality inherent in anthropomorphization. Organizations do not behave; people do. In contrast, the micro perspective has been guilty of neglecting contextual factors that can significantly constrain the effects of individual differences that lead to collective responses, which ultimately constitute macro phenomena (House et al., 1995; Klein et al., 1994; Roberts et al., 1978; Rousseau, 1985).

Macro researchers tend to deal with global measures or data aggregates that are actual or theoretical representations of lower-level phenomena, but they cannot generalize to those lower levels without committing errors of misspecification. This renders problematic the drawing of meaningful policy or application implications from the findings. For example, assume that we can demonstrate a significant relationship between organizational investments in training and organizational performance. The intuitive generalization—that one could use the magnitude of the aggregate relationship to predict how individual performance would increase as a function of increased organizational investments in training—is not supportable, because of the well-known problem of ecological inference. Relationships among aggregate data tend to be higher than corresponding relationships among individual data elements (Robinson, 1950; Thorndike, 1939). This fact continues to be a significant difficulty for macro-oriented policy disciplines—sociology, political science, economics, education policy, epidemiology—that attempt to draw individual-level inferences from aggregate data.

Micro researchers suffer from an obverse problem, which also makes the desire to influence human resource management policy difficult. We may, for example, be able to show that individual cognitive ability increases individual performance. However, we cannot then assert that selection systems that produce higher aggregate cognitive ability will necessarily yield improved organizational performance. Perhaps they will, but that inference is not directly supported by individual-level analyses. Misspecifications of this sort, however, are not unusual (Schmidt, Hunter, McKenzie, & Muldrow, 1979). Such “atomistic fallacies,” in which organizational psychologists suggest team- or organization-level interventions based on individual-level data, are common in our literature.

A levels approach, combining micro and macro perspectives, engenders a more integrated science of organizations. House and colleagues (1995) suggest the term *meso* because it captures this sense that organizational science is both macro and micro. Whatever it is called, we need a more integrated approach. The limitations that the organizational disciplines suffer with respect to influencing policy and applications can be resolved through the development of more complete models of organizational phenomena—models that are system-oriented but do not try to cap-

ture the complexity of the entire system. Instead, by focusing on significant and salient phenomena, conceptualizing and assessing at multiple levels, and exhibiting concern about both top-down and bottom-up processes, it is possible to build a science of organizations that is theoretically rich and application-relevant.

### **Formative Theory Development: The Emergence of a Levels Perspective**

Early efforts to conceptualize and study organizations as multilevel systems were based in the interactionist perspective (Lewin, 1951) and focused on the construct of organizational climate.<sup>2</sup> Those early efforts played a significant role in developing a “levels” perspective. Interactionists see behavior as a function of both person and situation, with the nature of the combined effect broadly conceived (as, for example, additive, multiplicative, and reciprocal; see Schneider, 1981; Terborg, 1981). Thus behavior is viewed as a combined result of contextual and individual-difference effects. The interactionist perspective has had a pervasive influence on organizational research. It has played a dominant role in shaping research on climate, first posited by Lewin, Lippitt, and White (1939). It continues to exert influence through research on person-organization fit.

As organizational psychology developed as a distinct subdiscipline in the 1950s, organizing climate emerged as a central construct for understanding organizational effectiveness. Researchers of this era described climate as a representation of “organizational stimuli” or “environmental characteristics” presumed to affect individual behavior and attitudes. Forehand and Gilmer (1964) reviewed the climate literature, highlighting problems of conceptualization and measurement. They criticized researchers’ failure to consistently and clearly distinguish whether climate was viewed as an objective property of the organization or as an individual perception, and they bemoaned the resulting confusion regarding whether climate should be assessed at the organizational level, via objective characteristics, or at the individual level, via perceptions.

James and Jones’s (1974) subsequent review helped to dispel much of this confusion. They distinguished objective characteristics of the organizational context, which are the antecedents of climate, from individuals’ interpretive perceptions, which ascribe



meaning to the context. This conceptualization views climate perceptions as a result of both contextual and individual influences. In addition, James and Jones distinguished psychological (that is, individual-level) climate from organizational climate, arguing that homogeneous perceptions could be aggregated to represent climate as a property of the organization. James and Jones's conclusions influenced the nature of climate research for the next two decades.

There were two critical contributions of this formative research on the development of a levels perspective in organizational science. First, this research made top-down cross-level contextual effects salient, establishing the need to conceptualize and assess organization, subunit, and group factors that had the potential to affect individual perceptions, attitudes, and behavior. This energized a stream of research that linked organizational structure and technology to individual attitudes (e.g., Herman & Hulin, 1972; James & Jones, 1976; Rousseau, 1978b). As this research progressed, models were elaborated to include mediating perceptions. Many studies were conducted that demonstrated that individual-level climate and/or job-characteristics perceptions mediated the linkage between contextual factors at higher levels (group, subunit, or organization) and individual-level outcomes (e.g., Brass, 1981, 1985; Oldham & Hackman, 1981; Kozlowski & Farr, 1988; Rousseau, 1978a). This work emphasized the importance of top-down cross-level contextual effects on lower-level phenomena. *Thus group and organization factors are contexts for individual perceptions, attitudes, and behaviors and need to be explicitly incorporated into meaningful models of organizational behavior.*

The second contribution of this research was to make salient emergent phenomena that manifest at higher levels. Although organizational policies, practices, and procedures are the antecedents of individual-level climate perceptions, individuals in organizations do not exist in a vacuum. People in groups and subunits are exposed to common features, events, and processes. They interact, sharing interpretations, which over time may converge on consensual views of the group or organizational climate (James, 1982; Kozlowski & Hattrup, 1992). Processes such as attraction, selection, and attrition; socialization (Schneider & Reichers, 1983); and leadership (Kozlowski & Doherty, 1989) also operate to reduce

the variability of individual differences and perceptions, facilitating common interpretations of the climate. In such conditions, individual-level perceptions can be averaged to represent higher-level group, subunit, or organizational climates (Jones & James, 1979; Kozlowski & Hults, 1987; Schneider & Bowen, 1985). This work emphasized the importance of bottom-up emergent processes that yield higher-level phenomena. *Thus individual social-psychological processes can be manifest as group, subunit, and organizational phenomena and need to be explicitly incorporated into meaningful models of organizational behavior.*

## Multilevel Organizational Theory and Research

### Overview

Although interest in the development and testing of multilevel theoretical models has increased dramatically in the past decade, there have been relatively few efforts to provide multilevel theoretical frameworks for organizational researchers (e.g., House et al., 1995; Klein et al., 1994; Rousseau, 1985). Multilevel theory building presents a substantial challenge to organizational scholars trained, for the most part, to “think micro” or to “think macro” but not to “think micro *and* macro”—not, that is, to “think multilevel.” Our goal is to explain fundamental issues, synthesize and extend existing frameworks, and identify theoretical principles to guide the development and evaluation of multilevel models.

In the first part of this section, we describe multilevel theoretical processes, providing insights into and principles for “thinking multilevel.” The issues we examine are central to the development of multilevel theories and provide conceptual guidance for theorists seeking to develop specific multilevel models. In the second part of this section, we focus on model operationalization. Most of the difficulties of conducting multilevel research have concerned the consequences of incongruent levels among constructs, measures, or analyses (for example, misspecification errors, aggregation biases, ecological correlation; see Burstein, 1980; Firebaugh, 1979; Freeman, 1980; Hannan, 1991; Robinson, 1950; Thorndike, 1939). We provide principles to guide the interested researcher through the problem of model specification.

The principles we derive are intended to be general guidelines applicable to most circumstances; they are not immutable laws. We acknowledge at the onset that the complexity of the issues involved in multilevel theory makes exceptions to the general principles inevitable. In such cases, theory takes precedence—that is the one overarching principle.

### Principles for Multilevel Organizational Theory Building

This section describes fundamental theoretical processes that provide the underpinnings for developing multilevel theories. We hope to assist readers in emulating and extending the best of current multilevel thinking. Toward this end, we highlight established principles and consider provocative new possibilities for multilevel theory building and research. For ease of presentation, we present central principles of multilevel theory building and research organized around the *what*, *how*, *where*, *when*, and *why* (and *why not*) of multilevel theoretical models.

#### What

On what should multilevel theory building and research focus? The possibilities are virtually endless, reflecting the full breadth of organizational processes, behavior, and theory. Nevertheless, a few guidelines regarding the process of choosing a focus for study are possible. First, we urge scholars to begin to fashion their theoretical models by focusing on the endogenous construct(s) of interest: What phenomenon is the theory and research attempting to understand? The endogenous construct, or dependent variable, drives the levels, constructs, and linking processes to be addressed by the theory. Too frequently, researchers begin theory development with the antecedents of interest: "These are interesting constructs; I wonder how well they predict generic outcomes." Such an approach invites the development of a trivial or misspecified theory. Without careful explication of the phenomenon of interest, it is exceedingly difficult to specify a meaningful network of potential antecedents.

**PRINCIPLE:** *Theory building should begin with the designation and definition of the theoretical phenomenon and the endogenous construct(s) of interest.*

Second, multilevel theory is neither always needed nor always better than single-level theory. Micro theorists may articulate theoretical models capturing individual-level processes that are invariant across contexts, or they may examine constructs and processes that have no meaningful parallels at higher levels. Similarly, macro theorists may develop theoretical models that describe the characteristics of organizations, distinct from the actions and characteristics of organizational subunits (groups, individuals). Although we think that such phenomena are likely to be rare, in such cases multilevel theory building is not necessary.

Finally, theorists may also find it impractical to develop multilevel models for processes, relationships, and outcomes new to organizational science; that is, when tackling phenomena previously unexplored in the organizational literature, a theorist may find it helpful to initially act as if the phenomena occur at only one level of theory and analysis. In this way, a theorist temporarily restricts his or her focus, putting off consideration of multilevel processes for a period. Huselid's work (1995) on strategic human resource management provides an example. Huselid has documented organization-level relationships among human resource practices, aggregate employee outcomes, and firm financial performance, but what are the cross-level and emergent processes—the linkages of individual responses to human resource practices—that mediate the relationship between organizational human resource practices and organizational performance? The time is now ripe for such multilevel theory building (Ostroff & Bowen, Chapter Five, this volume).

Having acknowledged that there may be instances in which multilevel models may be unnecessary, we also offer the following caveat: given the nature of organizations as hierarchically nested systems, it will be difficult in practice to find single-level relations that are unaffected by other levels. The set of individual-level phenomena that are invariant across contexts is likely to be very small. Similarly, the set of group- or organization-level phenomena that are completely uninfluenced by lower levels is also likely to be

small. Failure to account for such effects when they exist will yield incomplete or misspecified models.

**PRINCIPLE:** *Multilevel theoretical models are relevant to the vast majority of organizational phenomena. Multilevel models may, however, be unnecessary if the central phenomena of interest (a) are uninfluenced by higher-level organizational units, (b) do not reflect the actions or cognitions of lower-level organizational units, and/or (c) have been little explored in the organizational literature. Caveat: Proceed with caution!*

### How

By definition, multilevel models are designed to bridge micro and macro perspectives, specifying relationships between phenomena at higher and at lower levels of analysis (for example, individuals and groups, groups and organizations, and so on). Accordingly, a multilevel theoretical model must specify how phenomena at different levels are linked. Links between phenomena at different levels may be top-down or bottom-up. Many theories will include both top-down and bottom-up processes.

*Top-down processes: contextual influences.* Each level of an organizational system is embedded or included in a higher-level context. Thus individuals are embedded within groups, groups within organizations, organizations within industries, industrial sectors within environmental niches, and so on. Top-down processes describe the influence of higher-level contextual factors on lower levels of the system. Fundamentally, higher-level units may influence lower-level units in two ways: (1) higher-level units may have a direct effect on lower-level units, and/or (2) higher-level units may shape or moderate relationships and processes in lower-level units.

An organization has a direct effect on the behavior of its individual employees when, for example, its culture determines the accepted patterns of employee interaction and work behavior (for example, how formally employees address each other, or the extent to which employees question their supervisors' directives). An organization has a moderating effect on lower-level relationships when the relationship between two lower-level constructs changes as a function of organizational context. Thus, for example, the relationship between employees' conscientiousness and performance

may vary across organizational contexts. In contexts that provide autonomy and resources, conscientiousness may be associated with performance. However, contexts low on autonomy and resources are likely to constrain the effects of conscientiousness on performance, hence the relationship will be weak.

**PRINCIPLE:** *Virtually all organizational phenomena are embedded in a higher-level context, which often has either direct or moderating effects on lower-level processes and outcomes. Relevant contextual features and effects from the higher level should be incorporated into theoretical models.*

*Bottom-up processes: emergence.* Many phenomena in organizations have their theoretical foundation in the cognition, affect, behavior, and characteristics of individuals, which—through social interaction, exchange, and amplification—have emergent properties that manifest at higher levels. In other words, many collective constructs represent the aggregate influence of individuals. For example, the construct of organizational culture—a particularly broad and inclusive construct—summarizes the collective characteristics, behaviors, and values of an organization's members. Organizational cultures differ insofar as the characteristics, behaviors, and values of organizational members differ.<sup>3</sup>

Bottom-up processes describe the manner in which lower-level properties emerge to form collective phenomena. The emergence of phenomena across increasingly higher levels of systems has been a central theme of GST. Formative efforts to apply GST focus on the structure of emergence—that is, on the higher level, collective structure that results from the dynamic interactions among lower-level elements. The broad system typologies of Boulding (1956) and Miller (1978) attempt to capture the increasingly complex collectivities that are based on lower-level building blocks of the system. Thus, for example, interactions among atoms create molecular structure, or interactions among team members yield team effectiveness. This perspective views an emergent phenomenon as unique and holistic; it cannot be reduced to its lower-level elements (e.g., Dansereau et al., 1984).

A more contemporary perspective, one that has its roots in GST, derives from theories of chaos, self-organization, and complexity, and it views emergence as both process and structure. This

perspective attempts to understand how the dynamics and interactions of lower-level elements unfold over time to yield structure or collective phenomena at higher levels (Arthur, 1994; Gell-Mann, 1994; Kauffman, 1994; Nicolis & Prigogine, 1989; Prigogine & Stengers, 1984). This perspective is not a reversion to reductionism; rather, it is an effort to comprehend the full complexity of a system—its elements, their dynamics over time, and the means by which elements in dynamic interaction create collective phenomena (e.g., Cowan, Pines, & Meltzer, 1994). The two perspectives are compatible but different. We draw on this latter perspective and attempt to understand both process and structure in our conceptualization of emergence.

Emergence can be characterized by two qualitatively distinct types—composition and compilation—that may be juxtaposed as anchors for a range of emergence alternatives. To simplify the discussion that follows and make distinctions more apparent, we treat composition and compilation as ideal or pure types. Later in the chapter, we further elaborate their underlying theoretical differences, discuss interaction processes and dynamics that shape emergence, and explore forms of emergence that are more akin to composition or more akin to compilation. *Composition*, based on assumptions of isomorphism, describes phenomena that are essentially the same as they emerge upward across levels. Composition processes describe the coalescence of identical lower-level properties—that is, the convergence of similar lower-level characteristics to yield a higher-level property that is essentially the same as its constituent elements. *Compilation*, based on assumptions of discontinuity, describes phenomena that comprise a common domain but are distinctively different as they emerge across levels. The concepts are functionally equivalent—that is, they occupy essentially the same role in models at different levels, but they are not identical, as in composition. Compilation processes describe the combination of related but different lower-level properties—that is, the configuration of different lower-level characteristics to yield a higher-level property that is functionally equivalent to its constituent elements.

The distinction between composition and compilation forms of emergence is best illustrated with examples. Consider the composition model for psychological and organizational climate

(James, 1982; Kozlowski & Hattrup, 1992). It indicates that both constructs reference the same content, have the same meaning, and share the same nomological network (Jones & James, 1979; Kozlowski & Hults, 1987). For example, an organization's climate for service is a reflection of organizational members' shared perceptions of the extent to which organizational policies, procedures, and practices reward and encourage customer service (Schneider & Bowen, 1985). An organization's climate for service—whether positive or negative—emerges from the shared, homogeneous perceptions of organizational members. Thus individual and organizational climates are essentially the same construct, although there are some qualitative differences at higher levels. Organizational climate is more inclusive and may have some unique antecedents relative to its lower-level origin in psychological climate (Rousseau, 1988). Composition models based on isomorphic assumptions have been the primary means of conceptualizing emergent phenomena (Brown & Kozlowski, 1997; House et al., 1995). We describe collective phenomena that emerge through composition processes as shared properties, and we discuss them in more detail in a subsequent section.

Sometimes lower-level characteristics, behaviors, and perceptions may not coalesce. Instead, lower-level characteristics, behaviors, and/or perceptions may vary within a group or organization, and yet the configuration or pattern of lower-level characteristics, behaviors, and/or perceptions may nevertheless emerge, bottom-up, to characterize the unit as a whole. Consider, for example, individual and team performance. The compilation model for individual and team performance references performance as a functionally equivalent domain but specifies different antecedents and processes at different levels (Kozlowski, Gully, Nason, & Smith, 1999). Individual performance entails task-specific knowledge, skills, and abilities. Dyadic performance entails coordinated role exchanges. Team performance is a complex function of specific individual and dyadic—networked—contributions. Thus, in compilation models, the higher-level phenomenon is a complex combination of diverse lower-level contributions (Kozlowski, 1998, 1999). The form of emergence described by compilation is not widely recognized and yet is inherent in many common phenomena, including the domains of learning, performance, norms, power, conflict, and effectiveness,

among many others. Compilation-based emergent processes are relatively little explored from a multilevel perspective in the organizational literature. We describe collective phenomena that emerge through compilation processes as *configural properties* and discuss them in more detail in a subsequent section.

The type of emergent process is fundamentally affected by the nature of social-psychological interactions and can vary for a given phenomenon; that is, a particular emergent phenomenon may be compositional in some circumstances and compilational in others. Consider team performance once again. Team performance emerges from the behaviors of individual team members. But does team performance emerge as a result of the coalescence of the essentially identical behaviors of individual team members so that team performance simply reflects the sum or average performance of individual team members? Or is team performance the result of the array or pattern of individual team members' performance—the complex culmination of one team member's excellence on one task, another team member's excellence on a second task, and a third team member's fortunately inconsequential performance on yet a third task? The first conceptualization is an example of composition; the second is an example of compilation. Neither conceptualization is "right" in all circumstances. Rather, the determining factors are the dimension of interest for team performance, the nature of the team's work-flow interdependence, and the organizational context in which the team exists, among others. This example hints at the challenges inherent in explicating the precise bottom-up processes that yield many higher-level constructs. Despite the challenges, however, precise explication of these emergent processes lays the groundwork for operationalizing the construct—a point on which we elaborate later in this chapter.

**PRINCIPLE:** *Many higher-level phenomena emerge from characteristics, cognition, behavior, affect, and interactions among individuals. Conceptualization of emergent phenomena at higher levels should specify, theoretically, the nature and form of these bottom-up emergent processes.*

### Where

Virtually inseparable from the question of *how* is the question of *where*—that is, precisely where do top-down and bottom-up processes originate and culminate? The answers to these questions

specify the focal entities—the specific organizational levels, units, or elements—relevant to theory construction. Suppose, for example, that a theorist is interested in the influence of unit climate on individual actions. What is the level of interest? For example, is it group climate? division climate? organizational climate? the climate of the informal friendship network? In the passages that follow, we will first explore the nature of organizational units as evoked by multilevel theory and then describe processes that determine the strength of the ties that link organizational levels or units.

*Nature of organizational units.* All but the smallest organizations are characterized by differentiation (horizontal divisions) and integration (vertical levels). These factors yield myriad entities, units, or levels. In organizational research, levels of *theoretical interest* focus on humans and social collectivities. Thus individuals, dyads, groups, subunits, and organizations are relevant levels (units, or entities) of conceptual interest. The structure is hierarchically nested so that higher-level units encompass those at lower levels. Many writers (Brown & Kozlowski, 1997; Freeman, 1980; Glick, 1985; Hannan, 1991; Simon, 1973) assert the importance of using formally designated units and levels for specification; for example, leadership research typically defines the "leader" as the formal unit manager. Generally speaking, formal units can be defined with little difficulty, although there can be exceptions, where unit boundaries or memberships are fuzzy.

Yet organizations are social systems in which people define their own informal social entities (Katz & Kahn, 1966). A variety of phenomena may define units or entities that do not correspond with formal unit boundaries. For example, vertical dyad linkage (VDL) theory (Graen, 1976) posits the formation of in-and-out groups as distinctive entities within a formal unit. Rentch (1990) demonstrates that patterns of social interaction across formal units influenced consensus on organizational climate, indicating that informal entities affect sensemaking processes. Often unit specification is based on expedience rather than on careful consideration. This can be problematic when the phenomena of interest are examined within formal units but are driven by informal processes that yield nonuniform patterns of dispersion (Brown & Kozlowski, 1997). Therefore, levels and units should be consistent with the



nature of the phenomenon of interest (Campbell, 1958; Freeman, 1980).

*PRINCIPLE: Unit specification (formal versus informal) should be driven by the theory of the phenomena in question. Specification of informal entities that cut across formal boundaries, or that occur within formal units and lead to differentiation, requires careful consideration.*

*Determinants of the strength of ties linking organizational levels or units.* One overgeneralization of the systems metaphor is that everything is related to everything. In reality, some levels and units are much more likely than others to be strongly linked, through what Simon (1973) refers to as *bond strength*. The theorist needs to choose appropriate units and levels or risk a misspecified or ineffective theory. Bond strength and related concepts help to explain what is likely to be connected across levels, and why.

Simon (1969, 1973) views social organizations as nearly decomposable systems. In other words, limited aspects of the larger system can be meaningfully addressed without compromising the system's integrity. A social organization can be conceptualized as a set of subsystems composed of more elemental components that are arrayed in a hierarchical structure. The linkage among levels—individual, group, and organizational—and subsystems is determined by their bond strength, which refers to the extent to which characteristics, behaviors, dynamics, and processes of one level or unit influence the characteristics, behaviors, dynamics, and processes of another level or unit (Simon, 1973). The greater the implications of one unit's actions for another unit, the greater the strength of the bond linking the two units. Therefore, meaningful linkages increase in strength with proximity and inclusion, and they decrease in strength with distance and independence.

Other researchers have used similar concepts to express the same basic principle. Weick (1976) uses the concept of *coupling* to reference decomposable subsystems. House and colleagues (1995) describe *inclusion* as the proportion of a lower-level unit's activities that are devoted to a higher level; units that are highly included will be more closely linked to the higher level. Kozlowski and Salas (1997) use the term *embeddedness* to describe how lower-level phenomena are aligned with contextual factors and processes that

originate at higher levels in the organizational system; alignment reflects strong bonds or inclusion across levels. Technostructural factors such as organizational goals, technology, and structure, as well as enabling processes such as leadership, socialization, and culture, influence embeddedness. From an interactionist perspective, Indik (1968) and James and Jones (1976) assert that strong interactions between levels require propinquity of structure and process and alignment of content. Constructs and processes implicated in bond strength, coupling, inclusion, and embeddedness will be more strongly linked across levels for relevant units.

This has obvious implications for models that incorporate multiple levels or units. Proximal, included, embedded, and directly coupled levels and units exhibit more meaningful relations than distal levels or loosely coupled units. Moreover, the content underlying constructs at different levels has to have some meaningful connection. For example, work-unit technology and structure exhibit cross-level effects on individuals because they constrain the characteristics of jobs (Kozlowski & Farr, 1988; Rousseau, 1978a, 1978b). The levels are coupled and the content is meaningfully related in a common network of relations. In contrast, the potential effects of organization-level strategy on individual jobs is likely to be quite small. This does not mean that strategy has no effect; rather, its effects are mediated through so many intervening levels, units, and content domains that direct effects are likely to be very difficult to detect at the individual level because bond strength is weak and the focal content is not meaningfully related. The effects of strategy are likely to be indirect.

*PRINCIPLE: Linkages across levels are more likely to be exhibited for proximal, included, embedded, and/or directly coupled levels and entities.*

*PRINCIPLE: Linkages are more likely to be exhibited for constructs that tap content domains underlying meaningful interactions across levels.*

### When

Time is rarely a consideration in either single-level or multilevel organizational models (House et al., 1995), yet it is clearly the case that many if not most organizational phenomena are influenced and shaped by time. Here we explore three ways in which time may



be incorporated into a multilevel model, increasing the rigor, creativity, and effectiveness of multilevel theory building.

*Time as a boundary condition or moderator.* Many organizational phenomena have a unidirectional effect on higher- or lower-level organizational phenomena, but multilevel relationships are not always so simple; instead, over time the relationship between phenomena at different levels may prove bidirectional or reciprocal. A given phenomenon may appear to originate at a higher or lower level according to the theorist's assumption about the current time point in a stream or cycle of events. The failure, quite common, to make such assumptions explicit can lead to apparently contradictory models of the same phenomenon and to debates about its "true" level.

For example, organizational culture is more likely to be based on emergent processes, either when the organization is at an early point in its life cycle or when the organization is undergoing dramatic change. In effect, individual sensemaking and social construction are more active and have a greater impact when the organizational context is ambiguous or in a state of flux. Therefore development or change in organizational culture will appear to be a bottom-up process. Over time, however, culture becomes stable and institutionalized. Formative events that were salient during emergence become the stuff of myth, legend, and tradition. Founding members move on. New members are socialized and assimilated into enduring contexts that resist change. Therefore, organizational culture appears to have a top-down influence on lower-level units.

The distinction between the two perspectives just sketched does not have to do with which one represents the "true" model of organizational culture; both are veridical. A variety of factors and processes can influence the apparent direction, top-down or bottom-up, of a cross-level process. This illustrates the necessity for the theorist to explicitly specify the temporal assumptions for the phenomenon in question. Thus time may serve as a boundary condition for the model; for example, the theorist states that the model applies only to mature organizations, or only to new ones. Alternatively, in a theoretical model, time may serve as a modera-

tor of the phenomenon; for example, the theorist posits that the direction (top-down or bottom-up) and effects of the phenomenon vary as a function of the organization's maturity.

**PRINCIPLE:** *The temporal scope, as well as the point in the life cycle of a social entity, affect the apparent origin and direction of many phenomena in such a way that they may appear variously top-down, bottom-up, or both. Theory must explicitly specify its temporal reference points.*

*Time-scale variations across levels.* Differences in time scales affect the nature of links among levels (Simon, 1973). Lower-level phenomena tend to have more rapid dynamics than higher-level and emergent phenomena, which makes it easier to detect change in lower-level entities. This is one reason why top-down models predominate in the literature. For example, efforts to improve organizational outcomes (for example, quality) through training (for example, total-quality management, or TQM) assume emergent effects that originate at the individual level. Models of training effectiveness focus on the transfer of trained skills to the performance setting. Higher-level contextual support (for example, a transfer climate; see Rouiller & Goldstein, 1993) enhances transfer in such a way that the effects of TQM training on quality are relatively immediate. However, the effect of individual-level TQM training on organizational outcomes is emergent and requires a much longer time scale. Individual cognition, attitudes, and behaviors must combine through social and work interactions. Depending on the nature of the vertical transfer process, individual outcomes will compose or compile to the group level and, over longer time frames, will yield organizational outcomes (Kozlowski & Salas, 1997; Kozlowski, Brown, Weisbein, & Cannon-Bowers, Chapter Four, this volume). Thus contextual or top-down linkages can be manifest within short time frames, whereas emergent, bottom-up linkages necessitate longer time frames.

**PRINCIPLE:** *Time-scale differences allow top-down effects on lower levels to manifest quickly. Bottom-up emergent effects manifest over longer periods. Research designs must be sensitive to the temporal requirements of theory.*

One implication of this effect of time scale is that phenomena at different levels may manifest at different points in time. For example, Kozlowski and his colleagues have proposed that team performance compiles and emerges across levels, from individuals to dyads to teams, at different points in the team-development process (Kozlowski et al., 1994, 1999). Others, in related fashion, have noted that level of a relationship in a multilevel model—homogeneous groups, heterogeneous groups, or independent individuals—can be influenced by factors that, over time, change the level of the relationship (Dansereau, Yammarino, & Kohles, 1999).

*Entrainment: changing linkages over time.* The term *entrainment* refers to the rhythm, pacing, and synchronicity of processes that link different levels (Ancona & Chong, 1997; House et al., 1995). Coupling across levels or units is tightened during periods of greater entrainment. Entrainment is affected by task cycles and work flows, budget cycles, and other temporally structured events that pace organizational life (Ancona & Chong, 1997). For example, the concept of entrainment has been used in the group and team performance literature to capture the idea that work-flow interdependence is not necessarily uniform over time; rather, the degree of interdependence or coupling can vary significantly depending on the timing of events or acts that require a synchronous and coordinated response (e.g., Fleishman & Zaccaro, 1992; Kozlowski, Gully, McHugh, Salas, & Cannon-Bowers, 1996; Kozlowski et al., 1999; McGrath, 1990). Thus levels or units that ordinarily are loosely coupled will be tightly coupled during periods of synchronicity.

Accordingly, entrainment processes must be considered during theory construction. Further, entrainment has rather obvious implications for research designs that intend to capture entrained processes. At some points in the cycle, two entities or levels may be tightly coupled or entrained, whereas at other points they will be decoupled and will appear independent. This variability creates demands for precise theory and measurement in order to capture the coupling; data collection must be sensitive to entrainment cycles and periods.

**PRINCIPLE:** *Entrainment can tightly couple phenomena that ordinarily are only loosely coupled across levels. Theories that address entrained phenomena must specify appropriate time cycles and must employ those cycles to structure research designs.*

### *Why and Why Not?*

Argument by assertion is invariably a poor strategy for theory building. Argument by logical analysis and persuasion—argument that explains why—is always preferable. In multilevel theory building, explaining why is not merely preferable but essential. A great deal of organizational multilevel theory building spans organizational subdisciplines (industrial/organizational psychology and organizational theory, for example). Therefore, the unstated assumptions in a multilevel theory may be obvious to the members of one subdiscipline but not to the members of another, who are also interested in the new multilevel theory. Furthermore, multilevel theories often incorporate novel constructs (for example, team mental models, or organizational learning). The meaning of such constructs may well be obscured in the absence of thorough explanations concerning why. Finally, multilevel data analysis has been the subject of considerable and continuous debate. Conflicts regarding the best way to analyze multilevel models abate considerably, however, in the presence of carefully and fully explicated theoretical models (Klein et al., 1994) that make the choice of analytical strategy clear (Klein, Bliese et al., Chapter Twelve, this volume). Thus multilevel theorists must not only specify what, how, where, and when but also why: Why are relationships in the model conceptualized as top-down rather than bottom-up? Why are constructs conceptualized as compositional rather than compilational? Why are predictors assumed to have immediate rather than long-term consequences for the outcomes of interest?

Nearly as important as the question of why, and perhaps even more interesting, is the question of why not. Why might bottom-up processes *not* yield a group-level property? That is, why might members' perceptions *not* converge to form a shared unit norm or climate? Why might top-down processes *not* constrain relationships in an organizational subunit? Why might predictors, hypothesized to be influential over time, prove instead to have immediate

consequences? In exploring why not, theorists may refine their models, incorporating important insights and nuances. This adds diversity and depth to theory; it is how a science is built.

**PRINCIPLE:** *Multilevel theoretical models must provide a detailed explanation of the assumptions undergirding the model. Such explanations should answer not only the question of why but also the question of why not.*

In sum, rigorous multilevel theories must carefully consider what, how, where, when, why, and why not. In what follows, we explicate how these basic questions inform the definition and measurement of constructs in multilevel models. We then describe distinctive forms or frameworks that multilevel models may take, the kinds of research designs and samples necessary to test multilevel models, and possible data analytic strategies.

### Principles for Model Specification: Aligning Constructs, Measures, Models, Design, and Analyses

Many of the controversies and problems associated with multilevel research are based on misspecifications or misalignments among the theoretical level of constructs, their measurement, and their representation for analysis. Misalignment is a problem for any research design that incorporates mixed levels, but it is also a problem for single-level research that incorporates emergent constructs. The nature of these misalignments is well documented elsewhere (Burstein, 1980; Firebaugh, 1979; Freeman, 1980; Hannan, 1991; Robinson, 1950; Rousseau, 1985; Thorndike, 1939). The following are some common problems: blind aggregation of individual-level measures to represent unit-level constructs, use of unit-level measures to infer lower-level relations (the well-known problems of aggregation bias and ecological fallacies), and use of informants who lack unique knowledge or experience to assess unit-level constructs.

Misalignments degrade construct validity and create concerns about generalizability. To build theoretical models that are clear and persuasive, scholars must explicate the nature of their constructs with real care. Precise explication lays the foundation for sound measurement. Constructs that are conceptualized and measured at

different levels may be combined in a variety of distinctive multilevel models. Research design and analytical strategies need to be aligned with the levels inherent in these models. Principles relevant to these concerns are considered in the remainder of this section.

### Constructs in Multilevel Theory

*Construct level and origin.* Constructs are the building blocks of organizational theory. A construct is an abstraction used to explain an apparent phenomenon. The level of a construct is the level at which it is hypothesized to be manifest in a given theoretical model—the known or predicted level of the phenomenon in question. Although organizational theorists have often discussed “the level of theory,” we prefer to use the phrase *level of the construct* because mixed-level models, by definition, include constructs that span multiple levels; that is, generalizations are constrained by the level of the endogenous construct (“the level of the theory”), but other constructs in a model may be at higher or lower levels. Thus, in mixed-level research, the theoretical explanation will span several levels in the effort to understand an endogenous construct at a given focal level.

The first and foremost task in crafting a multilevel theory or study is to define, justify, and explain the level of each focal construct that constitutes the theoretical system. Remarkably, the level of many organizational constructs is unclear. This problem, we have noted, once plagued the climate literature. Researchers and critics asked whether climate was to be conceptualized and measured as an organizational (unit) construct or as a psychological (individual) one. Climate researchers resolved this question, differentiating explicitly between a consensual unit climate and its origins in psychological climate. However, the question of level is often unasked in other research. Consider the familiar construct of worker participation. What is its level? Is worker participation an individual-level phenomenon, describing the influence an individual exerts in unit decisions? Or is worker participation at the unit level, describing a set of formal structures and work practices (for example, quality circles) characteristic of units, not individuals? For the most part, the participation literature reveals neither clear consensus regarding the level of the construct nor explicit discussion of its level (Klein et al., 1994).

PRINCIPLE: *The theorist should explicitly specify the level of each construct in a theoretical system.*

In specifying the level of a construct, the theorist must build a targeted theory, or “minitheory,” of the phenomenon, explicating where, when, and how the construct forms and is manifest. Many phenomena we study in organizations have their theoretical origins in the cognition, affect, and behavior of individuals but emerge, through compositional or compilational processes, to manifest as higher-level phenomena. A given construct may be an individual-level construct in some circumstances and a unit-level construct in others. When a theorist specifies that a construct originates at the individual level and manifests at a higher level, the theorist must explicate when, how, and why this process occurs. The theoretical foundation for emergent effects must be at the level of origin. When psychological and social-psychological phenomena are emergent at higher levels, the researcher needs to distinguish the level of theoretical origin and the level at which the focal construct is manifest—the level of the construct. The researcher must also explain the theoretical process that yields higher-level emergence—the conditions in which the higher-level construct exists or does not exist. This is essential to determining an appropriate means of assessing and representing the emergent higher-level construct.

PRINCIPLE: *When higher-level constructs are based on emergent processes, the level of origin, the level of the construct, and the nature of the emergent process must be explicitly specified by the theory.*

We elaborate further in what follows, explaining links between the previously described principles of multilevel theory (what, where, when, how, why, and why not) and the definition, explication, and measurement of theoretical constructs. Our quarrel with much of the existing theoretical literature on organizations is not that authors are too complex in characterizing the multiple, even shifting, levels of their constructs but just the opposite: that, too often, authors’ conceptualizations of the theoretical processes and levels of their constructs lack important detail, depth, and complexity. We now consider different types of higher-level constructs and address the implications for measurement.

*Types of unit-level constructs.* Unit-level constructs describe entities composed of two or more individuals: dyads, groups, functions, divisions, organizations, and so on. In the organizational literature, many problems and controversies revolve around the definition, conceptualization, justification, and measurement of unit-level constructs. The “level” of many higher-level constructs (culture, leadership, or participation, for example) is often debated. The debate is due in part to the potential for these constructs to emerge from lower-level phenomena.

To help resolve the controversies and confusion that often surround the definition, meaning, and operationalization of unit-level constructs, we distinguish three basic types:

1. Global unit properties
2. Shared unit properties
3. Configural unit properties

Global unit properties differ from shared and configural unit properties in their level of origin. Global unit properties originate and are manifest at the unit level. Global unit properties are single-level phenomena. In contrast, shared and configural unit properties originate at lower levels but are manifest as higher-level phenomena. Shared and configural unit properties emerge from the characteristics, behaviors, or cognitions of unit members—and their interactions—to characterize the unit as a whole. Shared and configural unit properties represent phenomena that span two or more levels. Shared unit properties are essentially similar across levels (that is, isomorphic), representing composition forms of emergence. In contrast, configural unit properties are functionally equivalent but different (that is, discontinuous), representing compilation forms of emergence. Configural unit properties capture the variability or pattern of individual characteristics, constructs, or responses across the members of a unit. We elaborate in what follows, and then we discuss how the nature of a unit construct influences its measurement.<sup>4</sup>

*Global unit properties.* Global constructs pertain to the relatively objective, descriptive, easily observable characteristics of a unit that originate at the unit level. Global unit properties do not originate

in individuals' perceptions, experiences, attitudes, demographics, behaviors, or interactions but are a property of the unit as a whole. They are often dictated by the unit's structure or function. Group size and unit function (marketing, purchasing, human resources) are examples of global properties. There is no possibility of within-unit variation because lower-level properties are irrelevant; indeed, any within-unit variation is most likely the result of a procedure that uses lower-level units to measure the global property. If, for example, group members disagree about the size of their group, someone has simply miscounted. Unit size has an objective standing apart from members' characteristics or social-psychological processes. In contrast, "perceived group membership" is an entirely different type of construct.

*Shared unit properties.* Constructs of this type describe the characteristics that are common to—that is, shared by—the members of a unit. Organizational climate, collective efficacy, and group norms are examples of shared unit-level properties. Shared unit properties are presumed or hypothesized to originate in individual unit members' experiences, attitudes, perceptions, values, cognitions, or behaviors and to converge among group members as a function of attraction, selection, attrition, socialization, social interaction, leadership, and other psychological processes. In this way, shared unit properties emerge as a consensual, collective aspect of the unit as a whole. Shared unit properties are based on *composition* models of emergence, in which the central assumption is one of isomorphism between manifestations of constructs at different levels; the constructs share the same content, meaning, and construct validity across levels. When researchers describe and study shared unit properties, they need to explain in considerable detail the theoretical processes predicted to yield restricted within-unit variance with respect to the constructs of interest: How does within-unit consensus (agreement) or consistency (reliability) emerge from the individual-level characteristics (experiences, perceptions, attitudes, and so on) and interaction processes among unit members?

*Configural unit properties.* Constructs of this type capture the array, pattern, or configuration of individuals' characteristics within a unit. Configural unit properties, like the shared properties of a

unit, originate at the individual level. Unlike shared unit properties, however, configural unit properties are not assumed to coalesce and converge among the members of a unit. The individual contributions to configural unit properties are distinctly different. Therefore, configural unit properties have to capture the array of these differential contributions to the whole. Configural unit properties characterize patterns, distribution, and/or variability among members' contributions to the unit-level phenomenon. Configural unit properties do not rest on assumptions of isomorphism and coalescing processes of composition but rather on assumptions of discontinuity and complex nonlinear processes of *compilation*. The resulting constructs are qualitatively different yet functionally equivalent across levels.

Configural unit properties are relatively rare in the organizational literature, but they are not rare in organizations. We can distinguish two types of configural unit properties: *descriptive characteristics*, which reference manifest and observable features, and *latent constructs*, which reference hypothetical and unobserved properties of the unit in question. Descriptive characteristics are straightforward. For example, diversity—the extent to which unit members' demographic characteristics are dissimilar—is a configural descriptive unit property. However, whereas diversity is a manifest unit characteristic, it most likely has effects through latent constructs that tap underlying psychological differences (e.g., Millikin & Martins, 1996). For example, diversity in unit-level sex or age are descriptive characteristics that may be linked to unit-level variability for the constructs of attitudes and values.

Unit-level conceptualizations of constructs are often configural.<sup>5</sup> For example, the combination of team members' abilities or personality characteristics constitutes the configural properties of the unit (Moreland & Levine, 1992). Configural constructs may also capture the pattern of individual perceptions or behavior within a unit. For example, team performance is often regarded as a global property of the team, yet when individual team members perform different but interdependent tasks, team performance may be conceptualized as a configural construct; team members do not engage in identical behaviors (Kozlowski et al., 1999). Finally, network characteristics (for example, network density) are configural insofar as they depict the pattern of the relationships within a unit (or



network) as a whole (Brass, 1995). Configural unit properties are based on compilation models of emergence (e.g., Kozlowski et al., 1999). When studying configural unit properties, researchers need to explain in detail the theoretical processes by which different individual contributions combine to yield the emergent unit property—that is, how are the individual origins represented in the summary, pattern, configuration, or array of the unit-level property?

**PRINCIPLE:** *Theorists whose models contain unit-level constructs should indicate explicitly whether their constructs are global unit properties, shared unit properties, or configural unit properties. The type of unit-level construct should drive its form of measurement and representation for analyses.*

### **Levels of Measurement**

**Basic issues.** The level of measurement is the level at which data are collected to assess a given construct. Individual-level constructs should, of course, be assessed with individual-level data. Unit-level constructs, in contrast, may be assessed with either unit-level or individual-level data. When unit-level constructs are assessed with unit-level measures, an expert source (a subject matter expert, for example, or an objective archive) provides a single rating of each unit. When unit-level constructs are assessed with individual-level measures, unit members provide individual-level data (for example, individual ratings of climate, or individuals' reports of their own demographic characteristics), which are subsequently combined in some way to depict the unit as a whole. Rousseau (1985, p. 31) advises researchers to measure unit-level constructs with global (that is, unit-level) data whenever possible: "Use of global data is to be preferred because they are more clearly linked to the level of measurement, avoiding the ambiguity inherent in aggregated data." Klein and colleagues (1994, p. 210) note that when a researcher uses "a global measure to characterize a group, he or she lacks the data needed to test whether members are, indeed, homogeneous within groups on the variables of interest." Accordingly, Klein and colleagues (1994, p. 210) recommend that researchers use global measures to capture unit-level constructs only when the level of the construct is "certain" or "beyond question." Here, we elaborate on Rousseau's (1985) and Klein and col-

leagues' (1995) admonitions, advising that the level of measurement should be determined by the type of the unit-level construct.

**Individual-level constructs.** Individual-level constructs should, as already noted, be assessed at the individual level. For example, individuals may complete measures of their own job satisfaction, turnover intentions, self-efficacy, psychological climate, and so forth. In some cases, one or more experts may provide assessments of the characteristics of other individuals. This procedure can be used when the characteristic is observable, or when the informant has unique access to relevant information (Campbell, 1955; Seidler, 1974). A supervisor may describe his or her individual subordinates' performance behavior; an observer may record individual demographic characteristics, or a researcher may use archival records to assess individuals' ages, tenure, or experience. In each case, data are assigned to individuals and are considered individual-level data. Issues of measurement quality are, of course, still relevant.

**Global properties.** The measurement of unit-level variables is often more complex and more controversial. Least complex and least controversial is the measurement of the global properties of a unit. By definition, global properties are observable, descriptive characteristics of a unit. Global properties do not emerge from individual-level experiences, attitudes, values, or characteristics. Accordingly, there is no need to ask all the individuals within a unit to describe its global properties. A single expert individual may serve as an informant when the characteristic is observable, or when the informant has unique access to relevant information. Thus a vice president for sales may report his or her company's sales volume, a CEO may report a firm's strategy, or a manager may report a unit's function. Although these examples each use an individual respondent, the data are considered global unit-level properties.

**Shared properties.** In contrast, shared properties of a unit emerge from individual members' shared perceptions, affect, and responses. The theoretical origin of shared properties is the psychological level, and so data to assess these constructs should match the level of origin. This provides an opportunity to evaluate the composition model of emergence underlying the shared property;



that is, the predicted shared property may not in fact be shared, in which case the data cannot be averaged to provide a meaningful representation of the higher-level construct. Therefore, the data to measure shared unit properties should be assessed at the individual level, and sharedness within the unit should be evaluated. Given evidence of restricted within-unit variance, the aggregate (mean) value of the measure should be assigned to the unit. Several empirical examples of this approach to the conceptualization, assessment, and composition of unit-level constructs can be found in the literature (e.g., Campion, Medsker, & Higgs, 1993; Hofmann & Stetzer, 1996; Kozlowski & Hults, 1987). This approach ensures both that the data are congruent with the construct's origin and that they conform to the construct's predicted form of emergence, thereby avoiding misalignment.

*Configural properties.* When a construct refers to a configural property of a unit, the data to assess the construct derive from the characteristics, cognitions, or behaviors of individual members. Individual-level data are summarized to describe the pattern or configuration of these individual contributions. As before, theory—the operational definition of the emergent construct—drives the operationalization of the measure. Configural properties emerge from individuals but do not coalesce as shared properties do. Thus a researcher, in operationalizing the configural properties of a unit, need not evaluate consensus, similarity, or agreement among individual members except to rule out coalescence. The summary value or values used to represent the configural property are based on the theoretical definition of the construct and on the nature of its emergence as a unit-level property. A variety of data-combination techniques may be used to represent, capture, or summarize configural properties, including the minimum or maximum, indices of variation, profile similarity, multidimensional scaling, neural nets, network analyses, systems dynamics and other nonlinear models, among others. The mean of individual members' characteristics is generally not an appropriate summary statistic to depict a configural unit property, although it may be combined with an indicator of variance or dispersion (Brown et al., 1996). In the absence of within-unit consensus, means are equifinal, ambiguous, and questionable representations of higher-level constructs.

**PRINCIPLE:** *There is no single best way to measure unit-level constructs. The type of a unit-level construct, in addition to its underlying theoretical model, determine how the construct should be assessed and operationalized. As a general rule, global properties should be assessed and represented at the unit level. Shared and configural properties should be assessed at the level of origin, with the form of emergence reflected in the model of data aggregation, combination, and representation.*

*Establishing the construct validity of shared properties.* The assumption of isomorphism that is central to the conceptualization of shared constructs requires explicit consideration. There are two primary issues relevant to testing models with one or more shared unit properties:

1. Establishing the measurement model
2. Evaluating the substantive theoretical model

The issue of the measurement model addresses the construct validity of aggregated lower-level measures as representations of higher-level constructs. It is generally addressed through examining patterns of within-group variance. Consensus- or agreement-based approaches—for example,  $r_{wg(j)}$ —evaluate within-group variance against a hypothetical expected-variance (EV) term. Agreement is examined for each shared property measure for each unit: a construct-by-group approach. Consistency- or reliability-based approaches—for example, ICC(1), ICC(2), and within-and-between analysis (WABA)—evaluate between-group variance relative to total (between and within) variance, essentially examining interrater reliability for each shared property across the sample: a construct-by-sample approach (Kozlowski & Hattrup, 1992; Bliese, Chapter Eight, this volume).

These different treatments have been the source of some debate (e.g., George & James, 1993; Yammarino & Markham, 1992). Consensus approaches treat issues 1 and 2 as distinct (e.g., James, Demaree, & Wolf, 1984; James et al., 1993; Kozlowski & Hults, 1987; Kozlowski & Hattrup, 1992). The strength is that construct misspecification, for any construct in any group, is avoided. The disadvantage is that there may be insufficient between-group variance for model evaluation, and this problem will not be revealed

until data analysis. Consistency-based approaches treat the issues as more unitary (e.g., Yammarino & Markham, 1992). The strength is that both within and between variance are considered in the computation of reliability, and so aggregated measures also have adequate between variance for the evaluation of substantive relations. The disadvantage is that some constructs may not actually have restricted variance in some groups, and so there is some potential for construct misspecification, which may be masked in the construct-by-sample approach.

We assert that consideration of both within-group and between-group variance is critical. However, the particular approach chosen is a matter of consistency with one's theory and data. Both approaches have different strengths and drawbacks. In the appropriate circumstances, either of the approaches is acceptable; there is no universally preferable approach.

**PRINCIPLE:** *The assumption of isomorphism of shared unit properties should be explicitly evaluated to establish the construct validity of the aggregated measure. The selection of a consensus- or consistency-based approach should be dictated by theory and data; no approach is universally preferable.*

*Data source, construct, and measurement levels.* Individuals as sources of data play different roles in measuring the three different types of unit constructs. This observation highlights the distinction between the data source, on the one hand, and the level of the construct and its measurement, on the other. For example, a knowledgeable individual may act as the data source for a global unit property such as size, function, or strategy, but in such a case the level of measurement is not considered the individual but rather the unit as a global entity.

A single informant may provide the data to measure the figurative or distributional properties of a unit when the properties are directly and reliably observable, or when the informant has unique access to relevant information. For example, a supervisor may report the distribution of males and females in a unit. A manager may report unit members' tenure, thus providing the data necessary for the calculation of a unit's variability with respect to tenure. Individual-level performance data may be reported by a

team leader to assess the configuration of team performance. In these examples, the configurative construct is a unit-level construct even though the source is a single expert.

In contrast, a single individual may rarely if ever serve as the data source regarding a shared property of the construct. For example, it is generally not appropriate to use single informants (for example, a supervisor or a CEO) to assess unit or organizational climate; climate originates as individual interpretations and emerges via social interaction, and single informants are not uniquely situated to know the inner interpretations of multiple perceivers. Thus assessment should model the theory regarding the origin and nature of the construct.

**PRINCIPLE:** *Individuals may serve as expert informants for higher-level constructs when they can directly observe or have unique knowledge of the properties in question. As a general rule, expert informants are most appropriate for the measurement of global unit-level properties and observable (manifest) configurative properties. They are least appropriate for the measurement of shared properties and unobservable (latent) configurative properties.*

*Item construction.* Several authors have provided guidelines for item construction, primarily for the measurement of shared properties. In general, the advice is to focus respondents on description as opposed to evaluation of their feelings (James & Jones, 1974) and to construct items that reference the higher level, not the level of measurement (James, 1982; Klein et al., 1994; Rousseau, 1985). In practice, research has tended to use items framed at both the individual level (data source) and at higher levels. Recently, Chan (1998) distinguished these practices as representing different composition models of the constructs in question. For example, Chan views climate items referencing self-perceptions (for example, "I think my organization . . .") as constructs distinct from items that tap the same content but reference collective perceptions (for example, "We think the organization . . .")—what he refers to as "reference shift consensus."

Research that has tested the merits of this advice is, however, very limited. Klein, Conn, Smith, and Sorra (1998) have found that survey items referencing the unit as a whole (for example, "Employees'

work here is rewarding”) do engender less within-group variability and more between-group variability than comparable survey items that reference individual experiences and perceptions (for example, “My work here is rewarding”). However, many climate researchers assessing shared unit properties have used self-referenced items and have demonstrated meaningful within-unit consensus (e.g., Kozlowski & Hults, 1987; Ostroff, 1993; Schneider & Bowen, 1985). It may well be the case that item content is critically important to the unit of reference. Perhaps climate-related content (for example, “I think the reward system . . .”) that taps the broader work environment may be more robust to differences between self-reference versus collective reference. The perspective, whether the self or the larger unit, may be largely the same, whereas content that taps more variable properties (for example, “My job is . . .”) may be more sensitive to the point of view incorporated in the item.

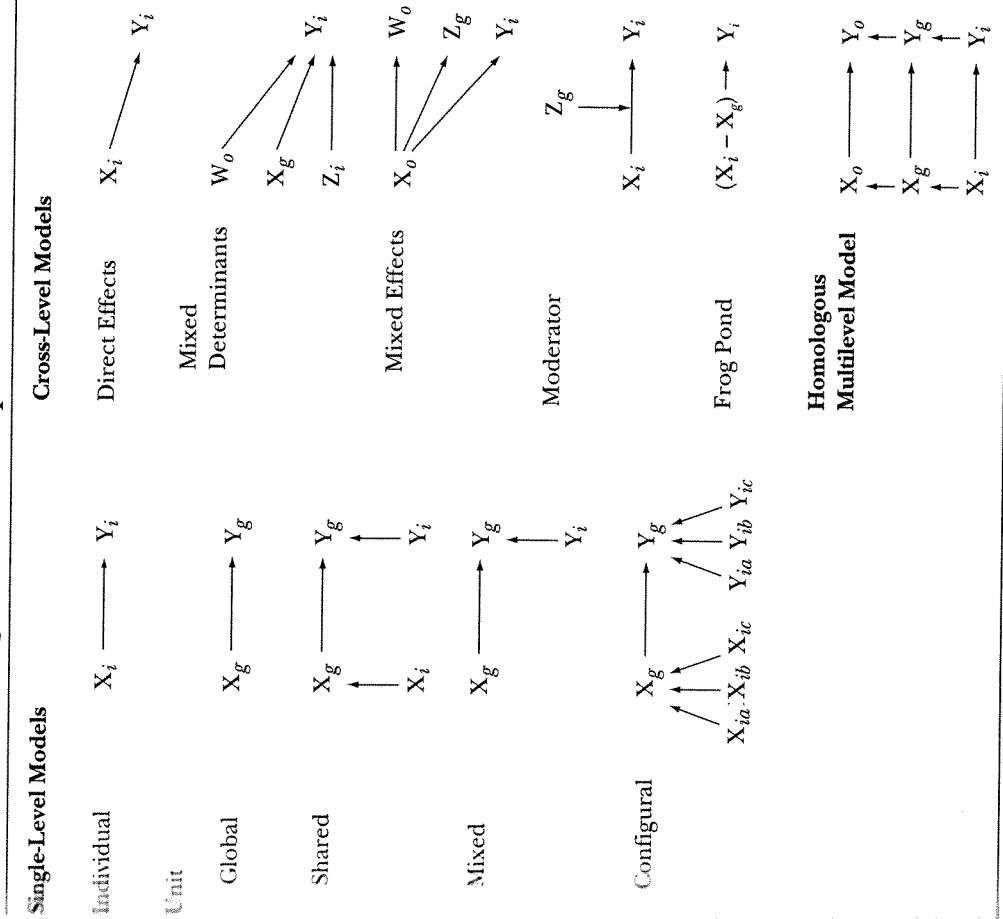
Clearly, more empirical work is needed to establish which item characteristics are critical to construct fidelity and which ones are not essential. In the meantime, we suggest that researchers employ measures consistent with the conceptualization of their constructs, using unit-level referents, if possible, to assess shared unit-level constructs. However, without more definitive empirical evidence, we do not encourage this as a litmus test and do not offer a principle. We do encourage more empirical research on guidelines for the construction of items to assess emergent constructs.

Types of Multilevel Models

Theoretical models describe relationships among constructs. A multilevel perspective invites—indeed, necessitates—special attention to the level of the constructs united within a theoretical model. In this section, we build on the preceding section by describing broad types of models distinguished by the levels of the constructs they encompass, as well as by the links they propose among constructs. Model specifications are illustrated in Figure 1.1. Following our description of basic models, we note further complexities in the creation of multilevel models.

*Single-level models.* Single-level models, as their name suggests, specify the relationship between constructs at a single level of theory

Figure 1.1. Model Specification.



and analysis. Such models are common in our literature and generally represent particular disciplinary perspectives. Psychologists are likely to find *individual-level* models the most familiar and straightforward type of single-level model. Individual-level models may be conceptually complex, specifying intricate interactional relationships among numerous constructs. However, individual-level models, by definition, ignore the organizational context of individual perceptions, attitudes, and behaviors. Thus the simplicity of individual-level models is in many cases a major limitation. Indeed, ignoring the context when it is relevant will lead to biases in the examination of construct relations (that is, the standard-error estimates of parameters will be biased).

Potentially far more complex are *unit-level* models, for these models may combine the three types of unit constructs in a variety of ways, in some cases necessitating mixed-level conceptualization, data collection, and analysis. Group-level models that depict the relationship of two global constructs are, from a levels perspective, the least complicated. To test these models, a researcher gathers unit-level data, consulting objective sources or experts to operationalize constructs. Tests of the effects of organizations' global human resource practices (for example, the presence or absence of merit pay and quality circles) on objective measures of organizational performance provide an example. But such models are very simple—perhaps too simple, like their individual-level counterparts. We suggest possible elaborations in what follows.

More complex, from a levels perspective, are unit-level models that include shared constructs. Consider a model linking two shared constructs: perhaps, for example, unit climate is hypothesized to predict unit morale. In proposing such a model, a scholar must explicate not only the processes linking the independent and dependent variables but also the processes engendering the emergence of climate perceptions and feelings of morale to the unit level: How do climate perceptions and feelings of morale, respectively, come to be shared by unit members? Further, to test such a model, a researcher must gather data from the level of origin—that is, from unit members—ascertaining the presence of restricted within-unit dispersion prior to aggregating data measuring the independent variable (climate) and the dependent variable (morale)

and conducting unit-level analyses. Thus a seemingly simple unit-level model may, if it includes shared constructs, effectively include a multilevel (compositional) model in the very definition and operationalization of each shared construct.

Unit-level models may also link global and shared constructs in direct and mediated relationships. A researcher may predict, for example, that global organizational human resources practices enhance global organizational performance by increasing the level of (shared) organizational citizenship behavior. In proposing such a model, a theorist moves beyond the simple unit-level model of global constructs (already outlined), offering a richer and more sophisticated analysis of the possible determinants of organizational performance. Ideally, such a theory explicates the influence of human resources practices on organizational citizenship behavior, the emergence of shared organizational citizenship behavior to the organizational level, and the influence of shared organizational citizenship behavior on global measures of organizational performance. Further, to test such a model, a researcher must, as before, collect individual-level data to tap the shared construct of interest.

Unit-level models incorporating configural constructs are also plausible. For example, the variation in cognitive ability within a unit may be predicted to influence global measures of unit performance. Or consider a more complex model: perhaps the personality configuration of a unit is predicted to influence unit creativity; that is, units with more diverse personality types may develop more creative ideas than units with less dissimilarity. Such a model requires not only the careful definition and operationalization of personality configuration but also the careful definition and operationalization of unit creativity. How does unit creativity emerge from the ideas and behaviors of unit members? Is it a shared construct—a unit average—or a configural construct, reflecting a more complex weighing, or configuration, of individual contributions? These questions hint at the rigor that a multilevel perspective may bring to the processes of theory building and theory testing. At first glance, the construct of unit creativity appears straightforward, unremarkable. But a further, multilevel examination indicates much work to be done in defining, explicating, and operationalizing the nature and emergence of unit-level creativity.

*Cross-level models.* Cross-level theoretical models describe the relationship between different independent and dependent constructs at different levels of analysis (Rousseau, 1985). Typically, organizational cross-level models describe the top-down impact of higher-level constructs on lower-level constructs (outcomes and processes). Although theory often conceptualizes the potential impacts of lower-level constructs on higher levels (the impact of newcomers on group cohesion, for example), bottom-up cross-level modeling is a distinct rarity in the empirical literature because of its analytic limitations. We should note, however, that recent work is beginning to address this problem (Griffin, 1997). Here, we outline three primary types of top-down cross-level models:

1. *Cross-level direct-effect models* predict the direct effect of a higher-level (for example, unit-level) construct on a lower-level (for example, individual-level) construct. Typically, such models predict that the higher-level construct in some way constrains the characteristics (for example, perceptions, values, or behaviors) of lower-level entities. Thus, for example, a cross-level direct-effect model may highlight the influence of unit technology on the nature of the individual job characteristics in each unit. Routine unit technologies are likely to yield jobs that are low in discretion, variety, and challenge. Conversely, uncertain technologies are likely to yield jobs high in discretion, variety, and challenge (e.g., Kozlowski & Farr, 1988; Rousseau, 1978a). Cross-level direct-effect models may, of course, highlight the effects of global, shared, or configurational unit properties on lower-level constructs. For example, unit norms (a shared construct) may constrain individual behavior, or the density of a unit's social network (a configurational construct) may influence individual satisfaction and turnover within the unit. Finally, cross-level direct-effect models may describe the influence not only of units on individuals but of other, higher-level entities (for example, industries) on lower-level entities (for example, organizations). Variants of cross-level direct-effect models include *mixed-determinant* and *mixed-effect* models (Klein et al., 1994). A mixed-determinant model specifies multilevel determinants (for example, both unit and individual) of a single-level (for example, individual-level) outcome or outcomes. A mixed-effect model specifies multiple-level outcomes of a single-level predictor. Thus, for example, an organiza-

tion's adoption and implementation of a new computerized technology may engender changes in the image of the organization to outsiders, in the extent to which distinct groups within the organization coordinate their work tasks, and in individual employees' feelings of job security as a function of their technical expertise and trust in the organization. Mixed-determinant and mixed-effect models may be combined to create complex cross-level models of antecedent and outcome networks.

2. *Cross-level moderator models* suggest that the relationship between two lower-level constructs is changed or moderated by a characteristic of the higher-level entity in which they are both embedded. One may also formulate the model so that a cross-level relationship between a higher-level construct and a lower-level construct is moderated by another lower-level construct. These two forms are actually identical because each model specifies direct and interactional effects of the higher- and lower-level constructs on a lower-level outcome measure. As an example, consider the effects of unit technology on the relation between individual cognitive ability and individual job performance. Generally, higher ability is associated with higher performance. However, routine unit technology limits individual discretion, thereby limiting the relevance of cognitive ability to performance. Conversely, uncertain unit technology fosters high individual job discretion, allowing cognitive ability to enhance job performance. Unit technology thus moderates the relationship of individual ability and performance.

3. *Cross-level frog-pond models* highlight the effects of a lower-level entity's relative standing within a higher-level entity. The term *frog pond* captures the comparative or relative effect that is central to theories of this type: depending on the size of the pond, the very same frog may be small (if the pond is large) or large (if the pond is small). Also called *heterogeneous, parts*, or *individual-within-the-group* models (Dansereau et al., 1984; Glick & Roberts, 1984; Klein et al., 1994), theoretical models of this type are cross-level models in that the consequences of some lower-level (typically individual-level) construct depend on the higher-level (typically group-level) average for this construct: where one stands relative to the group average. Consider, for example, the relationship between an individual's amount of education and his or her influence in problem-solving discussions within a group. A college-educated individual



may have a great deal of influence if his or her group members' average amount of education is relatively low (few graduated from high school), or very little influence if his or her group members' average amount of education is relatively high (most have postgraduate degrees). Thus the relationship between an individual's education and his or her influence in a group depends on the individual's relative standing within his or her group's degree of education. Frog-pond models of this type, we should note, may be categorized in different ways in levels typologies. We have classified frog-pond models as cross-level models, but we recognize that frog-pond models do not evoke unit-level constructs in the same way as the other cross-level models already described. The "group average" specified in a frog-pond model is not conceptualized as a shared property of the unit. Indeed, were the construct predicted to be shared within each group, then it would make no conceptual or empirical sense to assess individual standing on the construct relative to the mean—the hallmark of frog-pond models ( $X_i$  – the group mean of  $X$ ). Nor is the "group average" considered a global property of the unit; perhaps the group average, in combination with deviations, may be considered a configural property of the unit. This insight is subtle and complex, but it may help clarify why the frog-pond effect has been classified by some scholars as a distinct phenomenon or even as a distinct level of analysis. Just as we have created a distinct category for configural unit-level properties—unit properties that are characteristics of the unit but are neither global nor shared (isomorphic)—so others (e.g., Klein et al., 1994; Dansereau & Yammarino, Chapter Ten, this volume), in their conceptualizations, have designated frog-pond (heterogeneous or parts) models as a distinctive level.

*Homologous multilevel models.* These models specify that constructs and the relationships linking them are generalizable across organizational entities. For example, a relationship between two or more variables is hypothesized to hold at the individual, group, and organizational levels. Such models are relative rarities. The most commonly cited example of such a model is Staw, Sandelands, and Dutton's (1981) model of threat rigidity. Staw and his colleagues posit that the way in which individuals, groups, and organizations respond to threat is by rigidly persisting in the current response. By

arguing for parallel constructs and homologous linking processes, they have developed a homologous multilevel model of threat-rigidity effects. However, the model has not been tested empirically, its propositions are open to debate (e.g., House et al., 1995), and its attention to construct composition is limited. Lindsley, Brass, and Thomas's model (1995) of efficacy-performance spirals is an excellent example of a homologous multilevel model that carefully attends to the composition of its constructs. However, we know of no empirical test, in the published organizational literature, of a fully homologous multilevel model.

Given their generalizability across levels, homologous multilevel models are, at their best, uniquely powerful and parsimonious. At their worst, however, multilevel homologies may be trite. A search for parallel and generalizable constructs and processes may so reduce and abstract the phenomenon of interest that the resulting model may have little value at any level. The basic notion that goals influence performance at the individual, group, and organizational levels may be valid but not, at least in its bare-bones formulation, very interesting or useful. A hypothesis that is readily applicable to many levels may be a very basic hypothesis, indeed. In the literature there are examples of efforts to develop and apply homologous multilevel models to organizational behavior (e.g., Kuhn & Beam, 1982; Tracy, 1989), although these models have had little influence on theory or research. Thus the theorist must be aware of the tension inherent in the construction of multilevel models: good ones have the potential to advance and unify our field, but weak ones offer little to our understanding of organizational phenomena.

### *Sampling in Multilevel Research*

*Sampling within and across units.* When testing individual-level theoretical models, researchers endeavor to ensure that their samples contain sufficient between-individual variability to avoid problems of range restriction. Sampling issues in multilevel research are more complex but comparable. In testing unit-level theoretical models (for example, the relationship between organizational climate and organizational performance) and mixed-level models containing unit- and individual-level variables (for example, the relationship of organizational human resources practices and individual organizational commitment), researchers must endeavor to



ensure that their samples show adequate variability on the constructs of interest, *at all relevant levels in the model*. Thus, for example, it may be inappropriate to test a cross-level model linking a group construct to an individual outcome in a single-organization sample. If a higher-level organizational characteristic constrains between-group variability, it will yield range restriction on the measure of the group construct and preclude a fair test of the model. Unfortunately, this problem is all too common in levels research.

In testing models containing shared unit-level constructs, researchers must endeavor to obtain samples showing within-unit homogeneity *and* between-unit variability on the shared constructs. Thus, for example, if a theoretical model asserts that units develop shared norms over time and that these norms influence unit-level or individual-level outcomes, then a test of the model requires units in which individuals have worked together for a considerable period; newly formed task groups, for example, would provide an inappropriate sample for the study. The researcher's sampling goal, then, is to obtain experienced units showing shared norms that differ between the units. Alternatively, a researcher may explicitly model and gather data to test the hypothesis that the length of time unit members have worked together predicts the emergence of shared norms, which in turn influence unit-level or individual-level outcomes. In this scenario, the researcher's sample should contain units showing substantial variability in the length of time that unit members have worked together. This strategy allows a researcher to test the variable (time that unit members have worked together) hypothesized to engender the emergence of shared norms. The outcome measure for this hypothesis, then, is not the level or nature of a shared norm but the extent to which the norm is shared (or, conversely, its dispersion across group members).

The collection of data to test a multilevel model, or even a single unit-level model, is thus likely to be labor-intensive and time-consuming. It is not enough to sample many people in one organization. The multilevel researcher, whose variables include measures of shared and configural constructs, must sample many people in many units that are nested in many higher-level units. In other words, multilevel research generally necessitates sampling several organizations, units within these organizations, and indi-

viduals within these units. To be forewarned is to be forearmed: it is not reasonable to whine about range restriction in mixed-level data after the fact!

**PRINCIPLE:** *In the evaluation of unit-level or mixed unit-level and individual-level theoretical models, the sampling strategy must allow for between-unit variability at all relevant levels in the model. Appropriate sampling design is essential to an adequate test of such models.*

*Sampling across time.* In the section on theoretical principles (see "Principles for Multilevel Organizational Theory Building," pp. 21–25), we highlighted the importance of time, as well as its general neglect in theory construction for processes that link different levels. However, temporal considerations are important not only for theory; they are also essential to research design. Two issues are central: differential time scales across levels, and entrainment.

The first issue, differential time scales across levels, concerns the fact that higher-level and lower-level phenomena operate on different time scales. In general, lower-level phenomena change more quickly, whereas higher-level phenomena tend to change more slowly, and so it is easier to detect change in lower-level entities. This means that top-down cross-level relations, if present, can be readily detected with cross-sectional and short-term longitudinal designs. In related fashion, emergent phenomena generally need longer time frames to unfold and manifest at higher levels, and so bottom-up emergent effects require longitudinal designs.

**PRINCIPLE:** *Time-scale differences allow top-down cross-level effects to be meaningfully examined with cross-sectional and short-term longitudinal designs. Bottom-up emergent effects necessitate long-term longitudinal or time-series designs.*

The second issue, entrainment, concerns the fact that the links between some phenomena are cyclical; that is, the strength of a link may vary over time and will be detectable only during periods of entrainment. Therefore, a theory that includes entrained phenomena necessitates a very carefully timed research design that can sample relevant data during periods of entrainment. To the extent that such a theory represents an effort to evaluate entrainment as a

process, the design must also be capable of sampling relevant data during periods when the phenomena are not entrained.

*PRINCIPLE: Entrainment tightly links phenomena that are ordinarily only loosely connected across levels. Sampling designs for the evaluation of theories that propose entrained phenomena must be guided by theoretically specified time cycles, to capture entrainment and its absence.*

### *Analytic Strategies*

Several techniques are available for the analysis of multilevel data: analysis of covariance (ANCOVA) and contextual analysis using ordinary least squares (OLS) regression (e.g., Mossholder & Bedeian, 1983); cross-level and multilevel OLS regression; WABA (Dansereau et al., 1984); multilevel random-coefficient models (MRCM), such as hierarchical linear modeling (HLM; Bryk & Raudenbush, 1992); and multilevel covariance structure analysis (MCSA; Muthen, 1994). The techniques differ in their underlying theoretical assumptions and are designed to answer somewhat different research questions. Therefore, no single technique is invariably superior in all circumstances; rather, the choice of an analysis strategy is dependent on the nature of the researcher's questions and hypotheses. Here we see again the primacy of theory in dictating the resolution of levels issues. The best way to collect and the best way to test multilevel data will depend on the guiding theory. The more explicit and thorough the guiding theory, the more effective data collection and analysis are likely to be. We provide a brief overview of these analytic approaches here but direct the reader to later chapters in this volume for in-depth consideration of contextual and regression analysis (James & Williams, Chapter Nine), WABA (Dansereau & Yammarino, Chapter Ten), and multilevel random-coefficient models (Hofmann, Griffin, & Gavin, Chapter Eleven).

*ANCOVA and contextual analysis.* Among the earliest approaches to the analysis of cross-level data were adaptations of ANCOVA and the use of OLS regression to conduct contextual analysis (Firebaugh, 1979; Mossholder & Bedeian, 1983). The ANCOVA approach is used to determine whether there is any effect on an individual-level dependent variable that is attributable to the unit, beyond the effect accounted for by individual differences. Essen-

tially, this approach treats the individual-level variables as covariates and then uses unit membership as an independent variable to determine how much variance is attributable to the unit. Unit membership as a variable accounts for all possible remaining differences across units. Therefore, this approach cannot identify the specific constructs relevant to unit membership that are actually responsible for observed differences among groups; such effects are unexplained. Nevertheless, to the extent that there are any differences attributable to the grouping characteristic, this approach will capture it (Firebaugh, 1979).

The regression approach to contextual analysis typically uses aggregation and/or disaggregation to specify contextual constructs of interest. Although it is typically used to determine the effects of one or more higher-level contextual constructs on an individual-level dependent variable, it is actually flexible with respect to level. "Classic" contextual analysis includes individual-level predictors and unit means on the same predictors, to assess the relative amounts of variance attributable to the unit (Firebaugh, 1979). To the extent that unit means on the variables of interest account for variance beyond that explained by their individual-level counterparts, a contextual effect is demonstrated. This approach generally explains less variance than ANCOVA because the substantive unit variables are usually a subset of the total group composites effect, but it does identify the unit characteristic responsible for differences. Note that the aggregation process in classic contextual analysis is typically atheoretical (that is, no theoretical model of emergence is modeled), and isomorphism is not evaluated.

*Cross-level and multilevel regression.* In the organizational literature, OLS regression has been adapted to examine cross-level and multilevel effects and is quite flexible with respect to the type of model it can evaluate. Contemporary uses of this approach treat aggregation as an issue of construct validity (James, 1982; Kozlowski & Hattrup, 1992) so that a model of emergence is first evaluated before individual-level data are aggregated to the group level (e.g., Kozlowski & Hults, 1987; Ostroff, 1993). Therefore, with respect to the specification and measurement of construct types, this approach is relevant to the issues we have discussed in this chapter. Once the measurement model of the higher-level (aggregated)

constructs is established, the analysis proceeds to test substantive hypotheses. For example, if the theory assumes shared perceptions of unit climate as predictors of individual satisfaction, then one establishes restricted within-unit variance on climate, aggregates the data to the unit level (that is, computes means), and then disaggregates to the individual level of analysis (that is, assigns the means to individuals in the unit). The analysis then estimates the amount of variance in individual satisfaction that is attributable to unit climate. Individual-level analogues of the contextual construct are not necessarily controlled (as in contextual analysis) unless the question is of substantive interest (James & Williams, Chapter Nine, this volume).

*Within-and-between analysis.* The basic WABA equation (Dansereau et al., 1984) is modeled on the classic decomposition of within-and-between variance terms formulated by Robinson (1950) to model individual-level and aggregate group-level correlations. The "classical" WABA analysis examines bivariate relationships, assumes measures at the lowest level of analysis for all constructs, and proceeds in two phases. The first phase, WABA I, establishes the level of the variables. The second phase, WABA II, evaluates the level of relations between all the variables in the analysis (Dansereau et al., 1984). WABA I is designed to assess whether measures, treated one at a time, show variability in the following ways: both within and across units (as typically with an individual-level construct), primarily between units (as typically with a unit-level construct), and primarily within units (as with a frog-pond, parts, or heterogeneous construct). WABA II is designed to assess whether two measures covary in the following ways: both within and across units (as typically with individual-level relationships), primarily between units (as typically with unit-level relationships), and primarily within units (as typically with a frog-pond, parts, or heterogeneous relationship; see Klein et al., 1994). Although WABA was originally developed to examine bivariate relations at multiple levels, it has been extended to address multivariate relations (Schriesheim, 1995; Dansereau & Yammarino, Chapter Ten, this volume).

*Multilevel random-coefficient modeling.* The MRCM analysis strategy is represented by several packages of statistical software (for example, PROC MIXED in SAS; MLn; lme in S-PLUS), of which

HLM is probably the most familiar. HLM analysis assumes hierarchically organized, or nested, data structures of the sort that are typically encountered in organizations: individuals nested in units, units nested in organizations, and organizations nested in environments. Models of theoretical interest typically represent multiple levels of data. For instance, many cross-level models involve an outcome variable at the lowest level of analysis, with multiple predictors at the same and higher levels. HLM is well suited to the handling of such data structures.

The logic of HLM involves a simultaneous two-stage procedure. Level 1 analyses estimate within-unit intercepts (means) and slopes (relations). To the extent that unit intercepts and/or slopes vary significantly across units, Level 2 analyses treat them as outcomes. Thus Level 2 analyses model the effects of unit-level predictors on unit intercepts and slopes so that effects on intercepts are indicative of direct cross-level relations, and effects on slopes are indicative of cross-level moderation. HLM relies on a generalized least squares (GLS) regression procedure to estimate fixed parameters, and on the EM algorithm to generate maximum-likelihood estimates of variance components. This provides many statistical advantages over analogous OLS regression-based approaches (Hofmann et al., Chapter Eleven, this volume).

An in-depth description of these techniques is beyond the scope of this chapter; assumptions, applications, and differences among the techniques are addressed elsewhere in this volume. However, we will note here that all these techniques have the potential to be misused in an atheoretical attempt to establish "the" level at which effects occur. We reiterate that the conceptual meaning of higher-level aggregations (however they are statistically determined) must have an a priori theoretical foundation.

**PRINCIPLE:** *There is no one, all-encompassing multilevel data-analytic strategy that is appropriate to all research questions. Particular techniques are based on different statistical and data-structure assumptions, are better suited to particular types of research questions, and have different strengths and weaknesses. Selection of an analytic strategy should be based on (a) consistency between the type of constructs, the sampling and data, and the research question; and (b) the assumptions, strengths, and limitations of the analytic technique.*

## Extending Models of Emergent Phenomena

*Some of the most engaging and perplexing natural phenomena are those in which highly structured collective behavior emerges over time from the interaction of simple subsystems [Crutchfield, 1994, p. 516].*

A central theme woven throughout this chapter is the need for a more extended understanding of emergence as a critical multilevel process in organizational behavior. There is evident dissatisfaction with the overreliance on isomorphism-based composition as the primary model for conceptualizing collective constructs (House et al., 1995; Rousseau, 1985). Indeed, there is increasing recognition that emergence based on isomorphism may well be the exception rather than the rule. Although isomorphic emergence is a very powerful conceptual model, it is but one possible model. Emergent phenomena are not necessarily shared, uniform, and convergent. In their discussion of dispersion theory, a precursor to our typology, Brown and Kozlowski (1997, p. 7) note that nonuniform "phenomena marked by differentiation, conflict, competition, coalition formation, and disagreement are common" in organizations.

There are many theories, in our literature and others, that implicitly or explicitly address alternative forms of emergence. Power, conflict, and competition all involve compilational, discontinuous forms of emergence. The *variant paradigm* (Dansereau & Yammarino, Chapter Ten, this volume), with its interest in "parts" relationships, shows a recognition of the plausibility of compilation. This is a good beginning, but the "parts" perspective captures but one form of compilation among many. We argue that there is a need to extend the conceptualization of emergence, to make it more inclusive, so that our theories and research can encompass more varied and diverse emergent phenomena. We need to elaborate compilation forms of emergence.

## Conceptual Goals

### Purpose

Our purpose is to take a step toward this elaboration, describing forms of emergence that until now have received little attention in the organizational literature on levels of analysis. In preceding

sections of this chapter, we contrasted composition (shared unit properties) and compilation (configural unit properties) as distinctive, ideal types of emergence. This contrast was useful in making salient the important differences that affect conceptualization, measurement, and sampling. However, composition and compilation are not necessarily clear-cut dichotomous categories; rather, they are end points for a diverse set of emergence alternatives, with some forms of emergence being more akin to composition and some forms being more akin to compilation.

We now explore varying forms of emergence, hoping to foster increased attention to the structures and processes underlying emergent organizational phenomena. We undertake this exploration here by elaborating the theoretical underpinnings of emergence. First we consider, in greater depth, the theoretical foundation for emergence. A primary focus of our attention is the central role that interaction processes and dynamics among individuals play in shaping the form of the emergent phenomenon. Next, with this foundation in place, we identify more specific theoretical assumptions that distinguish the ideal or pure types of composition and compilation forms of emergence. We describe and illustrate how the assumptions change when one is considering discontinuous compilation relative to isomorphic composition. Finally, we develop a typology, posing a set of emergence exemplars that range between the ideal types of composition and compilation. We discuss each exemplar, providing examples from the literature that consider unit performance, unit learning–cognition–knowledge, and other unit phenomena, to illustrate how the theoretical assumptions help to explicate the nature of emergence for that exemplar. Our use of the typology is intended to help elaborate the theoretical underpinnings that shape the conceptualization of alternative forms of emergence.

### Contributions

There are three primary conceptual contributions of this effort. First, our intent is to be inclusive, encompassing multiple perspectives. Several recent theoretical efforts have started to explore emergence and the ways in which it may be manifest (Brown & Kozlowski, 1997, 1999; Brown et al., 1996; Chan, 1998; Kozlowski, 1998, 1999; Morgeson & Hofmann, 1999a, 1999b). Although these efforts are for the most part compatible, they have also chosen different points of theoretical



departure, different language, and different organizing structures. It is not our goal to explicitly integrate these efforts, but we believe our framework makes their compatibilities more explicit. We build on the strong theoretical and research foundation provided by isomorphism-based composition and elaborate it to embrace different alternative, and neglected forms of emergent organizational phenomena that follow from a consideration of discontinuity-based composition. Because compilation entails less restrictive assumptions, it allows for many more possible emergent forms relative to composition. We argue that a broader range of alternatives, from composition to compilation, is necessary to more fully capture complex emergence.

Second, an important contribution of our perspective is the recognition that higher-level phenomena do not necessarily exhibit universal forms of emergence; that is, a given phenomenon may emerge in different ways depending on the context and the nature of lower-level interaction processes. We need to attend to the ways in which interaction processes and dynamics shape the form of emergence. Therefore, the search for universal models of emergence, to be applied in each and every instance, may be misguided. Our perspective emphasizes that a collective phenomenon—unit performance—may emerge in a variety of different ways in different units. We need flexible conceptual tools that allow us to seek out, explore, and characterize variation in forms of emergence.

Third, our intent is to stimulate a more extended conceptualization of the theoretical mechanisms that characterize different forms of emergence. We develop a typology of emergence that explicitly links exemplars of different emergent forms to key theoretical underpinnings. Our focus is on theory development, not on mere classification. We are not advocating simple reductionist explanations for higher-level phenomena. We recognize that many organizational phenomena are top-down rather than bottom-up. Further, as we have already explained, many phenomena reflect both top-down and bottom-up processes unfolding over time. Moreover, we are not rejecting macro single-level approaches that do not explicitly address the emergent origins of the higher-level phenomena. Rather, we seek to promote more inclusive, extensive, and coherent explanations of collective phenomena. We are interested in both structure *and* process. We wish both to understand the whole *and* keep an eye on the parts.

The issues we address go to the conceptual meaning of higher-level phenomena that are rooted in individual characteristics and actions. Consider, for example, the global outcome of a baseball game score. One can examine a global predictor of this outcome (for example, average ability of team members), but this predictor can only provide a limited understanding of the team's performance. Baseball team scores are equifinal. True fans know this. They follow box scores so that they can understand how individual team members, in *dynamic interaction*, compiled the team score. We believe that a similar degree of conceptual understanding can pay big dividends in our effort to comprehend meso organizational behavior.



## Theoretical Underpinnings of Emergence

### What Is Emergence?

*Emergence is bottom-up and interactive.* The concepts undergirding emergence have broad expression in the biological, social, and physical sciences and are represented in theories of chaos, self-organization, and complexity (Arthur, 1994; Gell-Mann, 1994; Kauffman, 1994; Nicolis & Prigogine, 1989; Prigogine & Stengers, 1984) which address the dynamics of emergence. Our focus is on emergent phenomena that occur within the boundaries and constraints of organizational systems. Emergence is particularly relevant in the continuing effort of our science to understand how individuals contribute to organizational effectiveness. This is a central theme in several of the chapters of this book, including those focused on selection (Schneider, Smith, & Sipe, Chapter Two), performance appraisal (DeNisi, Chapter Three), training effectiveness (Kozlowski et al., Chapter Four), and human resources management (Ostroff & Bowen, Chapter Five). Emergence plays an important role in the linkages involved in interorganizational relationships (Klein, Palmer, & Conn, Chapter Six) and cross-cultural relations (Chao, Chapter Seven).

*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* (Allport, 1954; Katz & Kahn, 1966). Individual cognition, affect, behavior, and other characteristics denote *elemental content*. Elemental content is the raw material of emergence. Team mental models (cognition), group mood (affect), team performance (behavior), and

group diversity (other characteristics) all represent emergent group properties that have their origins in the elemental content provided by individuals. *Interaction* denotes process. Individuals communicate and exchange information, affect, and valued resources. They share ideas. They communicate mood and feelings. They perform acts and exchange work products. Communication and exchanges may be direct, as in face-to-face interaction, or indirect, as when information or other resource exchange is mediated via some form of technology. The form of the interaction process, in combination with the elemental content, comprises the emergent phenomenon.

*Emergence is shaped and constrained.* Although emergent phenomena have their origins in lower levels, the process of emergence is shaped, constrained, and influenced by higher-level contextual factors. Interaction in organizations is constrained by a hierarchical structure that defines unit boundaries. The individuals in a unit tend to interact more dynamically and intensely with each other than with individuals outside their unit (Simon, 1973). Moreover, work-flow transactions—the ways in which people are linked to accomplish the work of the unit (Thompson, 1967)—pattern interactions and exchanges. Individuals directly linked by the work flow tend to interact more with each other than with individuals who are only linked indirectly (Brass, 1995). Thus, for example, professors tend to interact more intensely with the students who are involved in their research than with the other students in their programs, and they interact more with students in their programs than with students in other programs. This patterning of interaction by formal structure and work flow shapes emergence.

In addition, informal patterns of interaction—social interaction that transcends formal boundaries and work flows—also shape emergence. People who cross unit boundaries to bond socially are more likely to communicate common perspectives. For example, Rentsch (1990) shows that individuals from different organizational units who met informally developed a shared conception of the organization's culture. In organizations, emergent phenomena are shaped by a combination of formal structure and work flows, and by informal social-interaction processes, with the relative importance of one, the other, or both dependent on the phenomenon of interest.

There are also a variety of other forces—such as attraction, selection, and attrition (ASA); common stimuli; socialization; and sensemaking—that affect interaction processes and dynamics. These forces, in combination with formal structures, work flows, and social structures, as already described, shape the nature of emergent phenomena. Generally, these forces have been conceptualized as constraining either the range of elemental content or the interaction process. Given these assumptions, the forces have been used to explain composition-based emergence, but they can also explain compilation. For example, the result of the ASA process is a workforce that is relatively more homogeneous in terms of ability, personality, attitudes, and values (Schneider & Reichers, 1983) and therefore more likely to have viewpoints in common. Organizational environments tend to expose employees to common stimuli—policies, practices, and procedures—that shape common perceptions (Kozlowski & Hults, 1987). Socialization can operate as a powerful force that shapes shared sensemaking (Louis, 1980). In these ways, the forces act as constraints shaping composition forms of emergence that are characterized by stability, uniformity, and convergence.

Sometimes the forces operate to expand rather than limit the range of elemental content or the nature of the interaction process. Compilation is based on the assumption that ASA, socialization, and related processes are not so powerful as to eliminate all meaningful differences in individual organizational members' elemental characteristics. Indeed, these processes may preserve or even engender variability within organizations, at least with respect to many important elemental qualities. For example, selection, attrition, and reward processes are unlikely to eliminate all variability in individual performance. Moreover, some organizations may well select individuals for their varying and idiosyncratic strengths, much as a sports team needs some players who are good on offense and other (typically different) players who are good on defense. Further, interactions among organizational members may engender similarity or dissimilarity; social interactions may unite or polarize employees. Finally, a variety of contextual factors limit an organization's ability (and often its desire) to build an organization of perfectly homogeneous individuals. Some measure of demographic variability is inevitable in most organizations, for example.



Figure 1.2. Theoretical Underpinnings of Emergence.



and amplifies related knowledge, in a spiral of collective knowledge acquisition (Nonaka, 1994).

The point of these examples is that given phenomena may emerge in different ways. A variety of contextual and temporal constraints operate to influence interaction dynamics among individuals, which in turn shape the emergent form, yet the dominance of composition models based on isomorphism has tended to limit consideration to shared models of emergence, and to the dichotomous presence or absence of emergence (Brown & Kozlowski, 1997). Theory needs to be able to capture the rich complexity of emergence rather than limiting emergence to universal conceptualizations that often do not exist.

### Theoretical Assumptions

Our framework is formulated around theoretical distinctions between ideal forms of composition and compilation, considered in earlier sections of this chapter. Here we turn our attention to three sets of overlapping assumptions, shown in Figure 1.2, that are useful for more finely distinguishing these alternative forms of emergence. The assumptions include the following elements:

1. The theoretical model of emergence, and the type and amount of elemental contribution implicated by the model
2. The interaction process and dynamics that shape the form of emergence
3. The resulting combination rules for representing the emergent form.

At the risk of some redundancy, we will outline these assumptions and apply them to the contrasting of composition and compilation forms of emergence. We will then present a typology, using the assumptions to distinguish alternative forms of emergence ranging between composition and compilation ideals.

*Model and elemental contribution.* Composition and compilation are distinguished by their underlying theoretical models. Composition is based on a model of isomorphism, whereas compilation is based on a model of discontinuity.<sup>7</sup> Isomorphism and discontinuity represent

differing conceptualizations with respect to the nature and combination of the constituent elements that constitute the higher-level phenomenon.

Isomorphism essentially means that the type and amount of elemental content—the raw material of emergence—are similar for all individuals in the collective. In other words, the notion of isomorphism is based on an assumption that all individuals perceive climate, for example, along the same set of dimensions, or that all team members possess mental models organized around the same content. In addition, isomorphism means that the amount of elemental content is essentially the same for all individuals in the collective. In other words, the climate or mental model is shared. Hence, within-unit convergence (that is, consensus, consistency, homogeneity) is central to composition. Morgeson and Hofmann (1999a, 1999b) describe this similarity in the type and amount of elemental content as *structural equivalence*. Thus isomorphism allows the theorist to treat a phenomenon as essentially the same construct at different levels (Rousseau, 1985). Note that isomorphic constructs are also *functionally equivalent*. That is, they occupy the same roles in multilevel models of the phenomenon; they perform the same theoretical function (Rousseau, 1985).

Discontinuity means that either the amount or type of elemental content is different, or both the amount and type are different. The notion of discontinuity is based on an assumption that the kinds of contributions that individuals make to the collective are variable, not shared and consistent. Essentially, there is an absence of structural equivalence in the nature of the elemental content and in the ways in which it combines (Kozlowski, 1998, 1999; Morgeson & Hofmann, 1999a, 1999b). Nevertheless, there is functional equivalence because the constructs perform the same role and function in models at different levels (Rousseau, 1985), as we shall explain.

The elemental content comes from a common domain—performance, personality, cognition—but the nature of individual contributions can be quite different. For example, baseball players contribute qualitatively different types and amounts of individual performance to accomplish team performance. The pitcher pitches, fielders field, and batters hit. In any given game, some will excel and others will make errors. Different dominant personality traits char-

acterize each team member. Team members possess different but compatible mental models of the game. Therefore, variability and pattern are central to compilation. Because the diverse elemental content is drawn from a common domain and contributes to a similar collective property, there is functional equivalence across levels. This functional equivalence allows the theorist to treat compilational properties as qualitatively different but related manifestations of the phenomenon across levels (Kozlowski, 1998, 1999; Morgeson & Hofmann, 1999a, 1999b).

*Interaction process and dynamics.* The hallmark of composition forms of emergence is convergence and sharing. In climate theory, for example, a variety of constraining forces have been proposed that are thought to shape the emergence of a shared collective climate. Individuals are exposed to homogeneous contextual constraints—common organizational features, events, and processes (James & Jones, 1974). They develop individual interpretations of these characteristics, yielding psychological climate. ASA processes operate to narrow variation in psychological climate (Schneider & Reichers, 1983). Interpretations are filtered and shaped by leaders (Kozlowski & Doherty, 1989). Individuals interact, communicate perspectives, and iteratively construct a common interpretation. Variations in individual interpretations dissipate as a collective interpretation converges. This is an incremental process that, over time, promotes stability, characterized by reduced dispersion as outliers are trimmed and by increased uniformity as perceptions are pushed to a convergent point. An equilibrium is achieved.

The hallmark of compilation forms of emergence is variability and configuration. Team performance requires that individuals coordinate and dynamically combine distinct individual knowledge and actions. The emergence of team performance is largely shaped by work-flow interdependencies—that is, the linkages that connect individual performance in the team work system (Brass, 1981). Consider once again the performance of a baseball team. There are any number of ways in which team members, working together, can achieve a particular score. They may excel because power hitters recurrently hit home runs. They may have a stable of good but not exceptional hitters; by consistently getting players on base the team is able to accumulate good scores. They may excel by

limiting the success of the opposing team; exceptional pitching, for example, will keep opposing scores low, and good defensive fielding, along with solid teamwork, will be needed to support the pitcher. Each player on the team will make distinctive individual contributions that combine in myriad ways to yield the team's performance. The *score* may be no more than the sum of its parts (that is, runs), but *team performance* is more than a simple sum of parts. Decomposing team performance necessitates an understanding of who did what, when, and of how it all fits together. This is an irregular process rather than incremental, stable interaction. There will be considerable dispersion and nonuniformity in the ways in which individual contributions are coordinated and combined to yield the compiled team performance (Kozlowski et al., 1999).

*Combination rules and representation.* The representation of an emergent construct is an effort to capture or freeze the result of a dynamic process. The assumptions identified earlier provide the basis for different combination rules—guidelines for summarizing or capturing a collective representation from the elemental content. For composition, similar types and amounts of elemental content that evidences relative stability, uniformity, and low dispersion will generally be summarized with linear additive or averaging rules. This procedure will yield a single indicator—a convergent point capturing the shared unit property. Collective climate, based on composition assumptions, is generally represented by unit means (Kozlowski & Hatrup, 1992). Homogeneous perceptions of worker participation are likewise represented as unit means (Klein et al., 1994).

For compilation, a variety of different nonlinear combination rules may be used to combine the different types and amounts of elemental content. Compilation interaction processes are irregular, high in dispersion, and nonuniform. Elemental content may vary in amount, kind, or both. Therefore, the combination rules for compilation are more varied and complex than those used to characterize composition. A sampling of potential combination rules includes disjunctive, conjunctive, and multiplicative combination models, and indices of variance, proportion, configurational fit, and network characteristics, among others (Levine & Fitzgerald, 1992; Meyer, Tsui, & Hinings, 1993). The key issue is that the combina-

tion rules should be consistent with the conceptualization of emergence. For example, if the compilation theory emphasizes team networks (Kozlowski et al., 1999), then the representation should capture such meaningful variation in network characteristics as centrality, transaction alternatives, and substitutability (Brass, 1981). If the theory emphasizes the formation of dyadic relationships, as in leader-member exchange (Graen, 1976), then the representation should capture relative standing on the basis of differences between leader-member pairs (Dansereau & Dumas, 1977). If the theory focuses on the formation of in-groups and out-groups (Kozlowski & Doherty, 1989), then the representation should capture in-and-out-group standing and differences (Brown & Kozlowski, 1997, 1999).

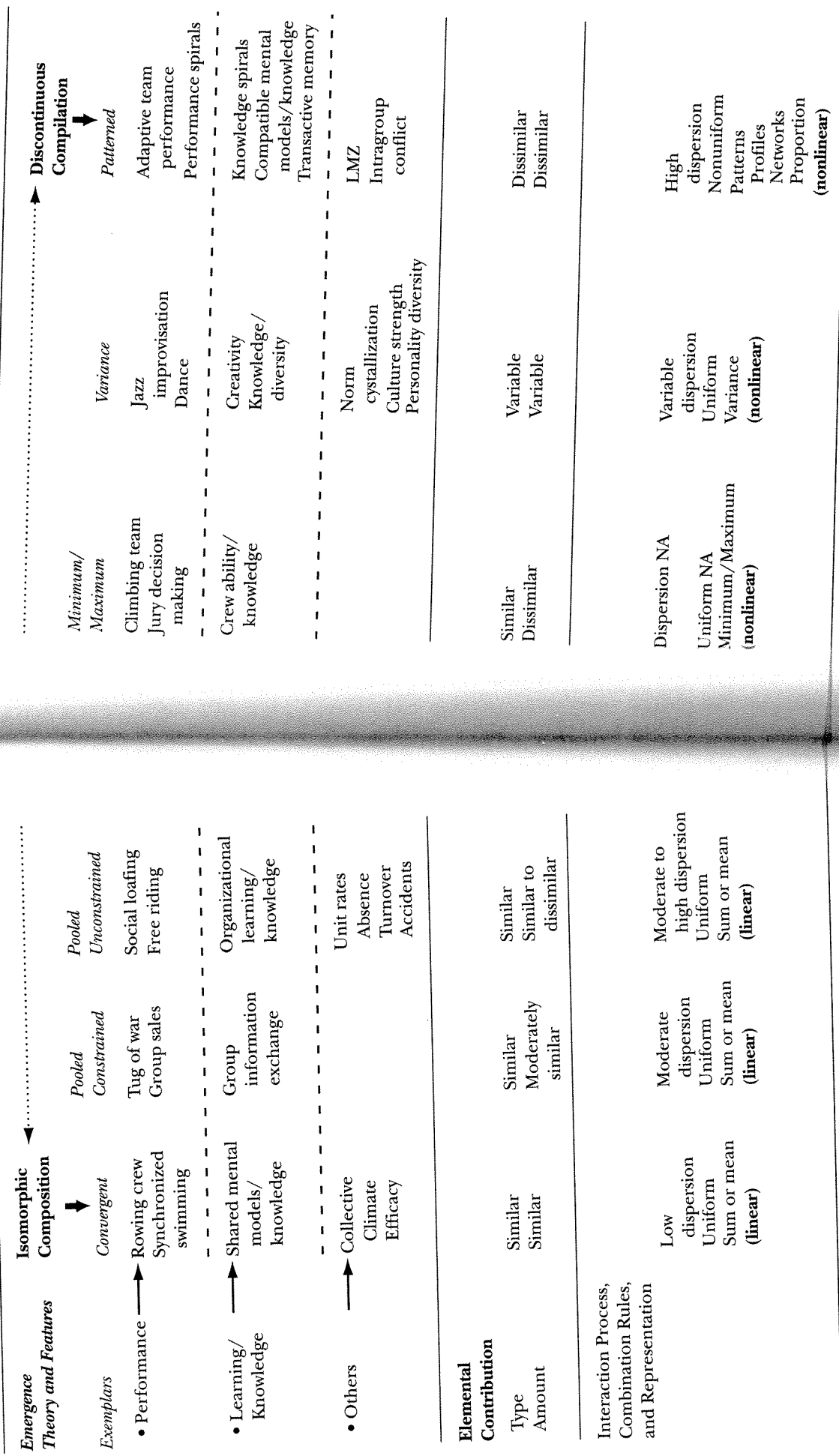
*Summary of distinctions between composition and compilation.* The key assumptions that distinguish composition and compilation, respectively, involve the question of whether the following elements are present:

1. Elemental (that is, individual) contributions to the higher-level phenomenon are similar (isomorphism) or dissimilar (discontinuity) in type, amount, or both
2. Interaction processes and dynamics are incremental and stable, exhibit low dispersion, and are uniform in pattern, or interaction processes and dynamics are irregular, high in dispersion, and exhibit nonuniform patterns
3. The emergent phenomenon is consequently represented by a linear convergent point (composition), or the emergent phenomenon is represented as a nonlinear pattern or configuration (compilation)

## A Typology of Emergence

The purpose of our typology is to promote a more expansive conceptualization of the theoretical mechanisms that characterize different forms of emergence. Our typology of emergence, shown in Figure 1.3, juxtaposes composition and compilation. The theoretical underpinnings derived previously are used to distinguish a variety of exemplars—specific emergence models. We discuss each exemplar, illustrating the exemplars with examples regarding

### Figure 1.3. Typology of Emergence.



collective performance, learning–cognition–knowledge, and other phenomena. We include exemplars for the following types of emergence: convergent, pooled constrained, pooled unconstrained, minimum/maximum, variant, and patterned. Each exemplar describes a different emergence process, based on contextual constraints and interaction processes, for how a lower-level phenomenon is manifested at a higher level. The nature of elemental contributions, in type and amount, and the combination rules applicable to each exemplar are indicated. Although we have used the individual and group levels to make the examples easier to explain, the models are applicable to higher levels as well. The typology is intended to help elaborate the theoretical underpinnings that shape the conceptualization of alternative forms of emergence.

### *Convergent Emergence*

The exemplar for this type of emergence represents the ideal form of composition that we have discussed throughout this chapter. The model is based on the assumption that contextual factors and interaction processes constrain emergence in such a way that individuals contribute the same type and amount of elemental content. Therefore, the phenomenon converges around a common point that can be represented as a mean or a sum. For example, the performance of a crew rowing a scull is dependent on each individual providing the same amount and type of physical thrust at precisely the same time. Synchronized swimmers must execute the same movements, in the same amount, at the same time. Similarly, the notion of team mental models is predicated on all team members sharing the same amount and type of knowledge (Klimoski & Mohammed, 1995). Ideal composition is also illustrated by theory and research on collective climate and collective efficacy. Group members' perceptions converge on the referent construct. Sharing is evaluated on the basis of consensus or consistency. Variability in elemental content and individual contributions is very low and uniform in distribution across members. Therefore, aggregation to the group mean eliminates the small amount of error variance and effectively represents the group on the higher-level construct.

Alternative subforms of this exemplar can be distinguished on the basis of the item referent used to create the emergent construct (Chan, 1998; Klein et al., 1998); that is, individual-level measures

may reference the self ("how I perceive") or the group ("how I believe the group perceives"). The self-referenced-item form is described by Chan (1998) as "direct consensus," and the group-referenced form is described as "referent shift consensus." This latter form is regarded as being more consistent with the conceptual underpinnings of the higher-level construct (James, 1982; Klein et al., 1994; Rousseau, 1985). Some research suggests that the referent-shift form may enhance within-group agreement and between-group variability (Klein et al., 1998). In related fashion, DeShon et al. (1999) indicate that aggregated group-referenced measures are better predictors of group performance than aggregated individual-referenced measures of the same construct. Empirical findings are preliminary at this point. Sometimes the item referent (self or group) makes a difference; at other times it does not. Clearly, this is an important issue that can be resolved only with systematic research.

### *Pooled Constrained Emergence*

This exemplar relaxes the assumptions for the amount of elemental contribution, but the type of content remains similar. The underlying model is based on the assumption that contextual factors and interaction processes shape emergence in such a way that some minimum amount of contribution is required of each individual. Therefore, there will be restricted variability within the group, yielding a pattern across individuals that is relatively uniform and moderate in dispersion. An additive or averaging model combines the elemental contributions.

Consider, for example, group sales performance for a district. Each salesperson makes an incremental, pooled contribution to group performance. The elemental contributions are similar in type but can vary in amount to some extent. Contextual constraints—such as incentives, competitiveness, leadership, and dismissal—are likely to restrict just how little can be contributed. All salespeople are not expected to contribute the same amount, but contributing too little will likely lead to turnover. Therefore, individual and group performance are not identical, but they are closely related.

Wittenbaum and Stasser (1996) provide a model of group discussion and consensus decision making consistent with this form of emergence. In their model, group members possess both



unique and common information that must be discussed and combined to yield a group decision. Although individuals possess both similar and dissimilar types of elemental content (that is, common and unique information), groups have been found to focus virtually all of their discussion on sharing the common information. In effect, the nature of social interaction processes constrains emergence so that only common information is discussed and used for the decision. Although there is some variation in individual contribution, the dissimilar information plays no role in the team product. The group decision is essentially an average of the shared information.

### *Pooled Unconstrained Emergence*

This exemplar fully relaxes the requirement on the amount of elemental contribution, but, as before, the type of content remains similar. Here, variation in the amount of elemental contribution can be quite high. For example, research demonstrates that performance in pooled tasks can be plagued by social loafing and free riding: some individuals contribute far less to the collective when the amount of their contributions cannot be identified (Harkins, Latane, & Williams, 1980). In such circumstances, the group product may be represented as a sum or mean. However, in contrast with the previous exemplar, the group representation and the individual contribution may be dramatically different. Similarly, one conceptualization of organizational climate is based on the assumption that within-group variation in climate perceptions is random measurement error (Glick, 1985, 1988). No restriction is placed on how much variability can be eliminated through averaging.

This exemplar is also frequently used for such group descriptive variables as absence, turnover, and accidents (e.g., Hofmann & Stetzer, 1996; Mathieu & Kohler, 1990). Unit rates are typically counts of the dichotomous presence or absence of some event: additive frequency counts, although sometimes these characteristics are summarized by means. Bliese (Chapter Eight, this volume) labels phenomena of this sort *fuzzy composition* because they lack the sharing that is the hallmark of composition. Other theorists have used group rates as examples of discontinuity (Rousseau, 1985), which is indicative of compilation. Therefore, these phenomena certainly represent fuzzy *something*; whether they are fuzzy compo-

sition or fuzzy compilation is not necessarily an important issue unless one is highly interested in classification. However, the fuzziness suggests that this exemplar captures a transition zone between the ideal types. Deeper conceptual digging may be useful for surfacing theoretical nuances that may help us better understand these differing forms of emergence.

One factor to consider in this deeper digging may be the base rate. In some instances, the elemental contribution can be spread across many (though not all) members of a unit—the incidence of stress, for example. In other instances, the rate is often predominantly influenced by the acts of just a few individuals—for example, serious accidents. Perhaps the first group of instances is more akin to fuzzy composition, and the second more akin to fuzzy compilation.

### *Minimum/Maximum Emergence*

This exemplar represents a shift from linear combination rules (that is, additive models) to nonlinear rules. Elemental contribution is based on similar content, but the amount of contribution is qualitatively distinct. Contextual factors and interaction processes constrain emergence so that the pattern across individuals is discontinuous. The standing of one individual on the phenomenon in question determines the standing of the collective. Therefore, dispersion and uniformity are not directly applicable to the conceptualization of this exemplar.

This is a conjunctive (minimum) or disjunctive (maximum) model, in which the highest or lowest value for an individual in the group sets the value of the collective attribute (Steiner, 1972). Consider, for example, group cognitive ability for a tank crew (Tziner & Eden, 1985) or a football team. It is not the average level or dispersion of cognitive ability that is important, because the same sort of cognitive contribution may not be necessary for all members; as long as one person is high on cognitive ability and the rest of the team will take direction, the group as a whole can effectively assess the situation and execute the appropriate strategy. Therefore, the maximum individual-level standing on the attribute determines the standing of the collective. This emergence process is similar to the jury decision-making model, in which a lone holdout (minimum) can yield a hung jury and a mistrial (Davis, 1992), or to a mountain climbing team whose performance is determined by the slowest and

weakest member of the team (e.g., Krakauer, 1997). Therefore, one individual can effectively determine the group-level outcome because the combination rule is nonlinear.

### *Variance Form of Emergence*

Unlike the other exemplars, which focus on representative values to capture the emergent characteristic of the collective, this form of emergence represents the phenomenon as variability within the group. Conceptually, this form of emergence is related to heterogeneity (Klein et al., 1994), parts (Dansereau & Yammarino, Chapter Ten, this volume), and uniform dispersion (Brown & Kozlowski, 1997; Brown et al., 1996; Chan, 1998). The elemental contribution may be similar in type and amount (for example, norm crystallization) or different in type and amount (for example, demographic diversity). Therefore, individuals may make contributions that are similar or different, but the substantive focus is on the variance of contribution (Roberts et al., 1978). It is important to emphasize that this one form captures different types of emergence that may range from low dispersion to high dispersion.

For example, one form of creativity can be characterized by the diversity, or lack thereof, of the knowledge or perspectives that are brought to bear on a problem (Wiersema & Bantel, 1992). Demographic diversity captures the extent to which individual members of a unit differ in their demographic characteristics (Tsui, Egan, & O'Reilly, 1992; Jackson et al., 1995). Homogeneity of charisma (that is, the extent to which a leader has equally charismatic relationships with all of his or her subordinates; see Klein & House, 1995), norm crystallization (Jackson, 1975), and culture strength (Koene, Boone, & Soeters, 1997) are based on variability within a collective. Homogeneity, crystallization, and strength are predicted on low variance, whereas the absence of homogeneity, crystallization, and strength is indicated by high variance. Klein and colleagues (Chapter Six, this volume) explore the antecedents and consequences of variability in organizational boundary spanners' trust in and commitment to their organization's interorganizational partner. Variance, of course, is a key operationalization of variability. Variance can capture emergence that differs across groups, contexts, and time. Therefore, it represents a shift in conceptual focus, from the content of the phenomenon to the nature of emergence itself.

### *Patterned Emergence*

This model is based on the widest variability in the type and amount of elemental contribution, and in the patterns by which those differences combine to represent emergent phenomena. This model incorporates the assumption that emergence may manifest itself as different forms, and it views nonuniform patterns of dispersion as meaningful substantive phenomena.

The variance form of emergence is based on uniform distributions of within-group dispersion, whereas the patterned or configural form is based on nonuniform distributions of within-group dispersion. The term *uniformity* refers to the pattern of the distribution. A uniform distribution is single-modal, indicating strong or weak *agreement*. A nonuniform distribution is highly skewed or multimodal, indicating strong or weak *disagreement* (that is, the formation of subgroup clusters). Indeed, this form is generally indicated by within-unit variance that exceeds what would be expected from purely random responding. Therefore, very high variance within a group may be indicative of polarized factions, or "faultlines," Lau and Murhighan's (1998) metaphor for the divisions that may erupt and split a group. In this sense, disagreement goes beyond lack of agreement; it is indicative of conflict or of opposing perspectives within the collective unit. It is in this respect that dispersion theory uses nonuniform patterns of subgroup bifurcation to capture such complex phenomena as conflict, polarization, competition, and coalition formation (Brown & Kozlowski, 1997, 1999).

In addition to patterns of subgroup bifurcation, this form of emergence includes configurations that attempt to capture networks of linkages. Consider, for example, the model of team compilation proposed by Kozlowski and colleagues (1999). The model specifies different types, amounts, and linking mechanisms to characterize performance contributions at the individual, dyad, and team levels. Adaptive team performance is represented as a configuration of compatible knowledge and actions across team members at different levels of analysis. Or consider notions of team mental models and transactive memory. Early notions of the team mental model concept assumed that all team members shared the same knowledge (e.g., Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1995). Therefore, early versions of this construct assumed isomorphic composition. As this concept has evolved in the literature, it has been reconceptualized as entailing different *compatible* knowledge

(Kozlowski, Gully, Salas, et al., 1996)—different knowledge across individuals that forms a congruent whole.

Similarly, Wegner (1995) proposes that individual group members may each have unique information essential to performing the group task. It is not necessary for individuals to share the same knowledge (that is, isomorphic assumptions); rather, one or more individuals simply need to know who possesses the unique information. The essential information can then be accessed, as necessary. In this model, group memory is a complex configuration of individual memory, distributed knowledge of the contents of individual memory, and the interaction process that links that information into an emergent whole.

### Implications

We introduced this third and last section of the chapter with three intentions: to be inclusive and expansive in our consideration of alternative forms of emergence, to focus on building a theoretical foundation for different forms of emergence, and to use typology as a vehicle for explicating and elaborating on the theoretical underpinnings of emergence. We hope that we have, in some measure, accomplished these goals. We believe, as we shall describe, that our framework is largely consistent with other efforts to explore emergence. We also believe that our particular attention to the underlying processes and dynamics that shape different forms of emergence can enhance understanding of the moderator effects and boundary conditions affecting emergence. An appreciation of the influence of these processes will lead to more precise specification of the theory addressing emergent phenomena. We see our effort as a point of departure for guiding and pushing further theoretical elaboration.

It is interesting to us that when our effort was originally conceived, we viewed our focus on different forms of emergence, and on the processes that shape those forms, as novel. However, a number of other researchers, contemporaneous with the development of this chapter, have also started to explore emergence (Brown & Kozlowski, 1997, 1999; Brown et al., 1996; Chan, 1998; Kozlowski, 1998, 1999; Morgeson & Hofmann, 1999a, 1999b). Although this chapter is not intended as an integration of these efforts, we believe that our framework helps to make explicit the compatibilities

across these apparently disparate efforts to explore emergence. For example, Brown and Kozlowski (1997, 1999) posit *dispersion theory*, which focuses on patterns of within-group variability or the dispersion of phenomena, as opposed to the more common focus on means or convergent points. In dispersion theory, uniform patterns that evidence low dispersion are consistent with composition processes, whereas subgroup bifurcation that creates nonuniform patterns of dispersion are consistent with compilation processes. Similarly, Morgeson and Hofmann (1999a, 1999b) have made a strong case for distinguishing construct *structure* and *function*. Structural and functional identity across levels is consistent with composition processes, and functional but not structural identity across levels is consistent with compilation processes.

Using examples from the literature, Chan (1998) has developed a typology to distinguish different types of "composition" or data-aggregation models. The typology includes additive models (e.g., Glick, 1985), direct-consensus models (e.g., James et al., 1984, 1993; Kozlowski & Hattrup, 1992), referent-shift-consensus models (e.g., James, 1982; Klein et al., 1994; Rousseau, 1985), dispersion models (e.g., Brown et al., 1996; Brown & Kozlowski, 1997), and process models (e.g., Kozlowski et al., 1994, 1999; Kozlowski, Gully, McHugh, et al., 1996). The direct-consensus, additive, and referent-shift-consensus models are consistent with composition processes, whereas the dispersion and process models are consistent with compilation processes.<sup>8</sup> Finally, our typology is also consistent with Steiner's (1972) typology of group performance. In many ways, Steiner's work is a precursor of all such typologies because it captures many of the basic combination rules that determine how individual characteristics, cognition, affect, and behavior can aggregate to represent higher-level, collective phenomena. We believe, as just discussed, that our framework is largely consistent with these other efforts. We also believe that our particular attention to the underlying processes and dynamics that shape different emergent forms enhances understanding of the moderator effects and boundary conditions affecting emergence. An appreciation of the influence of these processes will lead to more precise specification of theory addressing emergent phenomena.

We would be remiss if we did not note that there are also apparent inconsistencies between the contemporary treatments of

emergence (just noted) and other treatments with a tradition in the literature. We see the treatments as compatible yet different efforts to understand the same general class of phenomena. For example, the variant paradigm (Dansereau et al., 1984) treats emergence as a relationship between variables that exists at a higher, collective level but that does not hold between similar variables at a lower level. Thus, for example, a relationship between two variables is said to emerge at the group level of analysis if the two variables are significantly related (both statistically and practically) at the group level of analysis but the relationship between the two variables is not significant at the individual level of analysis. The variant perspective on emergence and our perspective are related but distinct. Dansereau and his colleagues focus on the emergence of relationships between variables at higher unit levels and on the statistical detection of such relationships. In contrast, we have focused primarily on the emergence of higher-level constructs, endeavoring to show the variety of ways in which a higher-level construct may emerge from lower-level entities and interaction processes. Measurement and analysis are important but separable issues. Ultimately, specific theories that assume particular emergent forms will need to be tested empirically. The variant paradigm, other analytic approaches, and even new techniques will be useful in this process.

We believe that the theoretical issues surrounding emergence that we have explored here are critical to the development of our science. How individual cognition, affect, behavior, and other characteristics emerge to make contributions to group and organizational outcomes is largely an uncharted frontier. How theories, interventions, and tools from the fields of industrial/organizational (I/O) psychology and organizational behavior (OB) can enhance these contributions is largely an unanswered question. Like most researchers and practitioners in the field, we believe that I/O-OB theories and techniques make contributions to organizational effectiveness, but we cannot really substantiate that belief (Rousseau, Chapter Fourteen, this volume). The chapters in this volume that deal with theory begin to explore this missing link. The chapter on training effectiveness (Kozlowski et al., Chapter Four), in particular, uses the distinction between composition and compilation to draw implications for how training can influence higher-level outcomes. We are beginning to probe a critical issue, but there is much more to do.

We make no claim that our framework is all-encompassing and complete; it is a work in progress. Although our focus has been primarily conceptual, the alternative forms of emergence have implications for measurement and analysis. We have endeavored to address measurement and data representation where possible, but we readily admit that the more complex compilation forms of emergence do not have well-developed measurement methods and analytic models. We hope that our pushing theorists to consider more complex phenomena will lead to new developments in methods and analytic systems. We hope the theoretical framework and typology presented here will stimulate further efforts to expand the conceptualization of emergent phenomena in organizations.

## Conclusion

As the next millennium approaches, we are poised to witness a renaissance in organizational theory and research. There is increasing recognition that the confines of single-level models—a legacy of primary disciplines that undergird organizational science—need to be broken. A meaningful understanding of the phenomena that comprise organizational behavior necessitates approaches that are more integrative, that cut across multiple levels, and that seek to understand phenomena from a combination of perspectives. There is a solid theoretical foundation for a broadly applicable levels perspective, for an expanding, empirically based research literature, and for progress toward the development of new and more powerful analytic tools. A levels perspective offers a paradigm that is distinctly organizational.

Our purposes in this chapter have been to review the conceptual foundations of the levels perspective in organizations, to synthesize principles for guiding theory development and research, and to elaborate neglected models of emergent phenomena. Our goal is to convince researchers that levels issues should be considered in the study of a broad range of phenomena that occur in organizations. We hope that this chapter will, in a small way, push researchers to use established frameworks and to explore new alternatives in their work.

The remaining chapters in this book apply a levels perspective to substantive topics, consider analytic methods, and reflect on the implications of the levels perspective for organizational science.

Several of the substantive topics were selected primarily because typical treatments of these topics in the industrial and organizational literature rarely consider the implications of levels, and yet levels issues are central. When the implications of a multilevel theory are considered, new and unexplored issues are surfaced. Prime examples of such topics include selection (Schneider et al., Chapter Two, this volume), performance appraisal (DeNisi, Chapter Three, this volume), training effectiveness (Kozlowski et al., Chapter Four, this volume), and human resource management (Ostroff & Bowen, Chapter Five, this volume).

Other topics were selected because they naturally embody a levels perspective, but a perspective that forces us to think beyond our current frameworks. Prime examples include cross-cultural (Chao, Chapter Seven, this volume) and interorganizational linkages (Klein et al., Chapter Six, this volume). Both chapters focus on the implications of individuals being representatives of the higher level collectivities to which they belong.

Next, there are chapters addressing each of the primary multilevel analytic methods and issues, including within-group agreement, non-independence, and reliability (Bliese, Chapter Eight, this volume); the cross-level operator and contextual analysis (James & Williams, Chapter Nine, this volume), within-and-between analysis (Dansereau & Yammarino, Chapter Ten, this volume); and hierarchical linear modeling (Hofmann et al., Chapter Eleven, this volume). In addition, we have endeavored to cut through to the heart of the assumptions, differences, and appropriate applications of these multilevel analytic techniques with a collaborative effort that combines our disparate knowledge and perspectives (Klein, Bliese et al., Chapter Twelve, this volume).

Finally, we close the book with reflective comments pertaining to the importance of the levels perspective to the deep historical roots of our science, and to the increasing centrality of levels theory in mainstream organizational theory and research (Brass, Chapter Thirteen, this volume). The multilevel perspective provides a means for us to unify our science, and creates a foundation for enhancing policy impact for the disciplines that study organizations (Rousseau, Chapter Fourteen, this volume). The authors of all these chapters have provided a wealth of ideas and actionable knowledge. We hope that these ideas, and this book, stimu-

lates those, who like us, seek a more unified and impactful science of organizations.

## Notes

1. Throughout this chapter, we use the term *multilevel* in a generic sense, to reference all types of models that entail more than one level of conceptualization and analysis. Therefore, our use of the term *multilevel* references composition and compilation forms of bottom-up emergence, cross-level models that address top-down contextual effects, and homologous multilevel models that address parallel constructs and processes occurring at multiple levels.
2. Any effort to briefly characterize the many and myriad contributions to multilevel theory in organizations is doomed from the outset to be incomplete. We recognize that there are other lines of theory and research that have contributed to multilevel theory; many are mentioned throughout this chapter. We have chosen, however, to focus on a very early, sustained, and reasonably coherent effort that spanned many decades and many contributors. Our apologies to all others.
3. We recognize that there are alternative perspectives on organizational culture that view it as a collective construct, one that cannot be decomposed to the individual level. However, research on organizational culture has become increasingly consistent with an emergent perspective (Denison, 1996).
4. Insofar as global, shared, and configural unit properties each describe a unit as a whole, they are "homogeneous constructs," as Klein and colleagues (1994) use the term; here, we elaborate on their typology, illuminating the variety of forms that homogeneous unit-level constructs may take.
5. Unit-level constructs may of course be compositional, as in situations where group members share identical values or the same attitudes, but we expect some characteristics, such as abilities and personality, to be more likely configural than shared.
6. We acknowledge that the conceptualization of phenomena *may* entail a universal form; for example, unit climate is often conceptualized as a unit property when it is shared and as an individual property when it is not (James, 1982).
7. Our definition of discontinuous phenomena is consistent with House and colleagues (1995). Note also that these authors propose three models of *relational* discontinuity, involving (a) magnitude, (b) relational patterns, and (c) behavior-outcome relations. We would characterize these models as top-down contextual models, not bottom-up emergent processes. These three models illustrate (a) cross-level direct effects,



(b) cross-level frog-pond relations, and (c) cross-level moderation, respectively. Our typology focuses on *discontinuity in emergence*.  
 8. We should clarify that Chan (1998) indicates that his additive, direct consensus, referent-shift consensus, and dispersion models are static, whereas the process model in his typology is more directly interested in the dynamics of emergence. We would argue that emergent processes dynamics are relevant to *all* the categories in that such processes shape the emergent form and, therefore, should be an explicit part of the conceptualization.

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## CHAPTER 2

# Personnel Selection Psychology Multilevel Considerations

Benjamin Schneider  
D. Brent Smith  
William P. Sipe

*History shows that great . . . forces flow like a tide over communities only half-conscious of that which is befalling them. Wise statesmen foresee what time is thus bringing, and try to shape institutions and model men's thoughts and purposes in accordance with the change that is silently coming on.*

JOHN STUART MILL

Industrial and organizational (I/O) psychology in general, and the subfield of personnel selection in particular, are experiencing a paradigm shift of which they may not be fully aware. The paradigm shift is from a focus on what Nord and Fox (1997) called the “essentialist individual” model of behavior to a newer focus on the organizational implications of personnel selection practices. From

*Note:* This chapter was prepared with the financial assistance of the Army Research Institute for the Behavioral and Social Sciences. The authors bear total responsibility for the content of the chapter; nothing in the chapter should be construed to represent positions of the U.S. Army and/or the Department of Defense.