TIME, CHANGE, AND DEVELOPMENT
The Temporal Perspective on Groups

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This article reviews literature that takes a temporal perspective on groups, focusing particularly on the theories that guide such work. The temporal perspective is a process-focused view that treats groups as systems in which change occurs across multiple time scales. The review is organized around six themes that have been especially generative: (a) Time is socially constructed; (b) time is a resource; (c) time is a fundamental issue for theory and research; (d) groups change systematically over time; (e) group processes have temporal patterns; and (f) groups are complex systems characterized by nonlinear dynamics. The article closes by identifying the need for continued theory development and testing to better integrate the disparate theories and findings found in literature inspired by the temporal perspective.

Keywords: small groups; group development; complex systems; time; change

Time and change are fundamental aspects of human existence, and like many fundamentals, they pose daunting challenges for research. This is certainly true in the study of small groups. Group research is a resource intensive process, and longitudinal designs

make the resource problem worse. Studying groups over time also raises the problematic issue of history. As group processes unfold in time and experience accumulates, groups change. Some change is systematic and regular; some is episodic and particular. Successful research on time and change in groups often requires many years of effort, the ability (and luck) to discern patterns in confusing data, and the willingness to innovate to capture an ever-changing subject.

The study of time and change in groups dates back at least to Kurt Lewin. Since his pioneering work, there have been many studies of time and change in small groups, but they are scattered across many fields, and they tend to represent small portions of the group research in any single field. Cumulatively, our progress in understanding time and change in groups is impressive, as this review documents. But just as impressive—and daunting—are the difficult issues that still face us and the vast areas of this terrain that remain largely unexplored.

DEFINITION, SCOPE, AND CORE THEMES

The temporal perspective is a process-focused view that treats groups as systems in which change occurs across multiple time scales, generated both by endogenous processes and by forces external to the group. Time is viewed in a variety of ways—as a context, as a resource, as a moderator or mediator of other processes. Change is also viewed in a variety of ways—as progressive, contingent, episodic, or continuous; and as endogenous or triggered by actors or events exogenous to the group. Although theo-

ries differ both in how they conceptualize time and in the specific dynamic variables of interest, they share an emphasis on describing temporal patterns and determining how variables interact and change over time within the group system or in its embedding context. We have organized this review around six themes—three related primarily to time and three related primarily to change—that represent different aspects of this literature.

We start with a brief overview of the six themes. Next, we review theoretical work tied to the three themes focused on time, and then we move to the topic of change in groups, also organized around three themes. We end with a discussion of possible future directions that identifies what we see as the primary challenges to be addressed in advancing our understanding of time and change in groups.

1. *Time is socially constructed*. This theme is central to work on the perception and understanding of time in groups. Studies that investigate the antecedents and consequences of different group conceptions of time fit this theme.
2. *Time is a resource*. Studies of how groups "manage" time and how time pressure (a resource shortage) affects group processes and outcomes fit this theme. It is inherent in all studies of how groups map activities to time.
3. *Time is a fundamental (and often problematic) issue for theory and research*. Scholars in several disciplines have noted that our conceptions of time shape the way we construct group theory, design research studies, and interpret our results.
4. *Groups change systematically over time; they develop*. This is the central theme of most group development work, which seeks to characterize the ways in which groups as systems change over time.
5. *Group processes have temporal patterns*. Work that fits this theme looks at the patterning of interaction in groups, including the sequencing of conversational turns, phases of group decision making, and changing patterns in member-group relations.
6. *Groups are complex systems characterized by nonlinear dynamics*. Models of groups as complex systems share an emphasis on time and change at multiple levels. Many focus on causal forces that operate between levels of analysis, on discontinuous change, and on historical processes such as path dependence.

TIME AND GROUPS

THE SOCIAL CONSTRUCTION OF TIME

How group members think about time, and collective group norms about the meaning of time, shape the way a group handles temporal matters. A useful classification proposed by Ancona, Okhuysen, and Perlow (2001) identifies five types of time: clock time, cyclical time (such as the succession of seasons), event time (subdivided into predictable and unpredictable) and life cycle time, which refers to development progression within a finite life span. Two examples of predictable events that structure time are paydays and religious holidays. Examples of unpredictable events that become reference points for things that happen before and after are major earthquakes or the September 11 attacks on New York and Washington in 2001.

One of the earliest studies of the social construction of time in a group is Roy's (1960) study of how four men counteracted the monotony of long hours of tedious machine work (objective time) by reconstructing time into a series of recurrent daily events, mostly organized around the procurement, sharing, stealing, and consumption of food and drink. The study illustrates how a group's construction of time can alter member experience and satisfaction.

A more common outcome variable in recent decades is group task performance, whether the focus is quality, quantity, or the ability to meet deadlines. Groups working on different types of projects are liable to construct time and temporal markers differently. Groups that rely on external pacers, for example, such as task forces working against an externally imposed deadline, should have a very different conception of what constitutes "late" than groups that are more internally focused (Ancona & Chong, 1996).

As Waller, Conte, Gibson, and Carpenter (2001) note, most work on the temporal perspective tends to assume a single, shared perception of time by all group members. Yet, how individual members socially construct time may vary. Waller et al. develop a series of propositions based on combining literature on time urgency (high vs. low) and time perspective (future vs. present ori-

ented) to yield four individual-level prototypes: organizers (high time urgency, future oriented), crammers (high time urgency, present oriented), visioners (low time urgency, future oriented), and relators (low time urgency, present oriented).

Waller et al. (2001) propose that under deadline conditions, teams composed of visioners and relators (both low urgency) will have difficulty meeting deadlines, whereas teams composed of organizers and crammers will not. They reason that the type of deadline should also matter, with "deep future" deadlines meshing better with teams composed of visioners and organizers and "shallow future" deadlines fitting teams of crammers and relators better. Finally, they propose that a temporal match between the time urgency and time perspective configuration of team members should have a positive impact on overall team performance.

TIME AS A RESOURCE

The objective construction of time, which is strongly influenced by Newtonian conceptions (McGrath & Kelly, 1986), lends itself to economic metaphors of time as money. As a scarce, valuable commodity, time should be used wisely, not wasted, and saved where possible. In work groups and organizations, this metaphor underlies notions of productivity and efficiency, which refer to the "return on investment" realized for a particular unit of time. This approach fits well with an input-process-output model of group functioning.

Viewing time as a resource makes it easier to study. Researchers can manipulate how much time different groups have to complete a task, or can alter the amount of time a group has during successive tasks in an experiment, and observe how this affects interaction and performance. Kelly and colleagues (e.g., Kelly, Jackson, & Hutson-Comeaux, 1997; Kelly & McGrath, 1985) have produced a sophisticated body of work on this topic, which explores the impact of time pressure on individuals, dyads, and groups performing assigned tasks. Such studies illustrate the manipulation of objective time as an independent variable, the use of time allocation as an outcome variable, and the impact of sequencing, a "history" effect.

Experimental studies of time as a dependent variable typically look either at how a fixed amount of time is allocated or how much time groups take to complete a task under different conditions—for example, communicating face-to-face versus via a computer-mediated communication system (see Hollingshead & McGrath, 1995, for a review of this work).

Although a group's pattern of time allocation may emerge with little explicit discussion, activities related to deliberate time management of a task-oriented nature (e.g., planning, scheduling, prioritizing) are found in many groups (e.g., McGrath, 1990, 1991; Weingart, 1992).

A new line of research on how groups manage time investigates monochronic versus polychronic ways of organizing work. Hall (1983) uses these terms to distinguish cultures in which people tend to do one thing at a time (monochronic) or several things simultaneously (polychronic). Applied to groups (Waller, 2000), it refers to a group's tendency to work on a single task at a time or multiple tasks simultaneously.

**TIME AS A FUNDAMENTAL ISSUE
IN THEORY AND RESEARCH**

A growing chorus of scholars inspired by this theme is calling for more sophisticated attention to time in theory development and empirical research (e.g., Arrow, McGrath & Berdahl, 2000; McGrath & Kelly, 1986; McGrath & Tschan, 2004; Poole, Van de Ven, Dooley, & Holmes, 2000; Zaheer, Albert, & Zaheer, 1999). Responding to this call requires that we wean ourselves from the current overemphasis on cross-sectional "snapshot" studies. It also requires that we attend more closely to the timing and sequence of events.

To exemplify this theme, we focus on Zaheer et al.'s (1999) analysis of the role of time scales in theory and research design. The quantitative meaning of a time scale is the size of a temporal interval, whether objective or subjective. In group interaction, relevant time scales can range from split-second timing to hours, days, months, or even decades.

According to Zaheer and colleagues (1999), scholars need to attend to five types of time scales: (a) The *existence interval* is the time needed for one instance of a phenomenon to occur. Applied to stage theories of group development, for example, the existence interval would be the group's full life span. (b) The *observation interval* is the time over which a process is observed. For a group development study, the observation interval would be whatever segment of the group's life was captured in the study. (c) The *recording interval* is the frequency with which a phenomenon is measured. In a study of group development, this would refer to how often measurements of the group are taken. (d) The *aggregation interval* is the time scale across which recorded information is aggregated for analysis. The aggregation interval for a group development study might be either interval driven (e.g., 10-minute segments of conversation) or event driven (a single meeting of the group). (e) The *validity interval* defines the temporal boundaries of the theory—the time scale over which the theory holds. Specification of the validity interval clarifies the range of time scales to which a theory applies. For example, does it apply to groups that form and disband in a matter of minutes? To groups that persist for decades, such as families?

A theory is "time-scale complete" if it specifies time scale for all of its variables, relationships, and boundary conditions. Otherwise, researchers cannot make theory-driven choices of observation, recording, and aggregation intervals, and the criteria for evidence either in support of or contrary to theoretical predictions remain unclear.

Zaheer and colleagues point out some parallels (and some differences) between levels of analysis and time-scale issues (1999, p. 737). Group theorists are increasingly recognizing the need to specify the level of analysis—individual, group, or organization, for example—at which constructs exist. Researchers are also increasingly exhorted to justify the aggregation of individual-level data to measure group-level constructs. Ideally, justification consists of both an aggregation model and evidence that the data conform to the model's requirements (Bliese, 2000). Applied to time scales, this suggests that researchers should give the reasoning

behind and support for any decisions to aggregate across observations into blocks of time.

CHANGE IN GROUPS

Theories of change in groups address three key concepts: change, stability, and continuity. Change is an alteration in the nature of group interaction or performance, in the state of the group as a whole, or a second-order change in the patterning of group process. Shifting levels of dynamic variables over time serve as indicators of change processes.

Stability processes dampen fluctuations, maintaining groups in their current state, or restore groups to a prior equilibrium, countering the impact of external or internal forces for change or transformation.

Continuity occurs in groups that experience change while maintaining and reenacting consistent patterns and structure. Broad theories of dynamic processes in groups address the interplay of change and continuity, stability and instability in groups that adjust to shifting forces while persisting across time as coherent collective entities.

In this section, we start with theories of group development, which consider how groups as a whole change across their full lifespan. Next, we move to temporal patterning at shorter time scales or for a particular strand of group process. We end with complex systems models that link processes at different time scales and levels of analysis.

SYSTEMATIC CHANGE OVER TIME

The core theme in group development is that groups as a whole change systematically over time. Studies of group development span half a century and include impressionistic studies, which rely on experiences and reflections of observers (e.g., Bennis & Shepard, 1956; Bion, 1961), empirical studies using observational systems (e.g., Bales, 1950; Gersick, 1988), studies based on archi-

val materials (e.g., Worchel, 1994), and cross-sectional survey studies (e.g., Wheelan, Murphy, Tsumura, & Kline, 1998).

Two typologies of change theories provide frameworks for distinguishing among the plethora of group development models. The first, based on a review of theories in the social, biological, and physical sciences, identifies four distinct "motors" for generating change (Poole et al., 2000). *Life cycle* models describe the process of change as the unfolding of a prescribed sequence of stages following a program that is immanent within or imposed upon the entity. *Teleological* models describe change as a purposeful movement of an entity toward one or more goals, with adjustments based on feedback from the environment. *Dialectical* models see change as emerging from conflict between opposing entities and eventual synthesis leading to the next cycle of conflict. *Evolutionary* models depict change as emerging from a repeated cycle of variation, selection, and retention, and generally apply to change in a population rather than change within an entity over time. Theories of change often draw on more than one motor, allowing for 15 categories of theories based on different numbers and combinations of motors.

A second framework (Arrow, 1997) distinguishes group development theories based on whether the primary forces promoting change and stability are internal or external to the group. Internal forces promoting change or stability often correspond to the social entrainment model's notion of rhythm—endogenous cyclic and developmental processes across multiple time scales, and mesh—synchronization of rhythms within and across different time scales (McGrath & Kelly, 1986). However, it also includes disruptions of rhythms (second-order change) that arise from within, including those generated by a teleological motor. External forces promoting change or stability correspond to the social entrainment notion of pace—external events and cycles that affect the rhythms and mesh of the system of interest.

Sequential stage models. These models identify a fixed sequence of qualitatively different stages through which a group passes as part of its naturally unfolding life cycle. This cycle corre-

sponds to the slowest rhythm of change identified in the social entrainment model (McGrath & Kelly, 1986), and change is viewed as endogenous: No external cues are necessary for moving from one stage to the next. On the contrary, interventions by outsiders or other externalities may arrest the natural course of development so that a group becomes stuck in a particular stage and fails to progress. Members are presumed to be entrained to the same dominant focus of the group—which corresponds to a mesh process— although the stages vary in whether they emphasize in-phase (convergent) or antiphase (conflictual) processes. Life cycle is the dominant motor, although a dialectical motor is sometimes evoked as a mechanism for moving from stage to stage (e.g., Bennis & Shepard, 1956).

Reviewers of the group-development literature (e.g., Tuckman, 1965; Wheelan, 1994) report substantial evidence of patterns consistent with stage theory, although the number of stages proposed varies. Here we describe the five-stage version that is most widely cited.

The initial stage focuses on issues of inclusion and dependency. Members attempt to identify behaviors acceptable to the leader and other group members, and early group meetings are characterized by member anxiety (Bion, 1961; Mann, Gibbard & Hartman, 1967). During the second conflict stage (Bennis & Shepard, 1956; Mann et al., 1967), group members deal with issues of power, authority, and competition. Confrontations with the leader help establish solidarity, and members clarify common values, which increases group stability.

As conflicts are resolved, the group moves to the third stage, devoted to the development of trust and characterized by more mature and open negotiation regarding goals and group structure, including roles and division of labor. This prepares the group for the fourth work stage, during which task orientation is high and ideas and feedback are exchanged openly (Bennis & Shepard, 1956; Tuckman, 1965). Groups that have a distinct ending point experience a fifth stage of termination, which may evoke disruption and conflict (Mann et al., 1967) but also the expression of positive feelings (Lundgren & Knight, 1978).

More sophisticated versions of stage theory allow for alterations of a fixed sequential progression (e.g., Bennis & Shepard, 1956; Mann et al., 1967; Wheelan, 1994). The smooth passage of groups in achieving the maturity of the work stage is not assumed. External disruption or membership change may arrest development or result in regression to a previous stage (Wheelan, 1994, p. 18). Hill and Gruner (1973) found that groups may also skip early stages if several of the members have been together in a previous group, demonstrating a carryover effect of member continuity. When groups get stuck, external intervention may be required to get a group moving again.

Repeating cycle models. These models treat change as central to group process yet reject the notion of sequential progression. The endogenous rhythms they follow have cycle times shorter than the lifetime of the group, so that cycles repeat. The models differ in the complexity of cycles described and in their focus on what in the group is changing. All imply that resolution of certain issues is only temporary (Bion, 1961; Worchel, 1994).

The oldest and simplest cycle model proposes that groups swing between focusing primarily on the task to focusing on socioemotional matters that preserve group solidarity (Bales, 1950). This rhythm continues for the life of the group.

A more recent cyclic model, based on a study of archival records of a wide variety of groups, proposes six stages through which groups cycle (Worchel, 1994). In the *discontent* stage, the group is not a significant part of members' identities. Members feel alienated and participation is low. To move past this stage, the group needs a *precipitating event* that sparks renewed member interaction. As members coordinate a response to the event, they rediscover commonalities and develop hope that the group can change. As members renew their commitment, the group enters the *group identification* stage, during which the group defines (or redefines) its boundaries and makes sharp distinctions between members and outsiders. The group becomes an important part of member identity. As group and member identity solidifies, the group moves into the *group productivity* stage, marked by energetic collective work

focused on reaching group goals. Boundaries weaken to allow new members in who might help reach those goals. As the group achieves its goals and gains resources, it enters the *individuation* stage. Members demand recognition for their contributions. The group remains important to members, but they focus on their own needs. As member needs eclipse group needs in importance, intragroup competition increases and the group begins to *decay.* As competition wanes and members put less energy into the group, alienation increases and the group returns to the discontent stage.

Cyclic models emphasize endogenous processes, and the engine for change is oppositional tension. Thus, the dialectical motor is the best fit, although in the case of the simplest cycles, the movement is like a pendulum swing, with no true synthesis or progression. The most complex and fully dialectical model in this category proposes that groups change as they repeatedly explore three sets of paradoxes: the paradoxes of belonging, based on the tension between group and individual; the paradoxes of engaging, based on the tension between involvement and detachment; and the paradoxes of speaking, based on the tensions created by multiple sources and targets of influence (Smith & Berg, 1987).

Robust equilibrium models. These models emphasize early change in the process of establishing a stable state, which is then maintained through a process of self-regulation that dampens or counters external disruption (Arrow, 1997). Change within the group is primarily apparent in the early phase of self-organization, and here we can posit a modified evolutionary motor operating on the early variation provided by members. In this interpretation, groups start by exploring or "trying on" a variety of possible roles and norms, and then they select and retain a single structure. Bales (1955) found that in the first meetings of a group, a tentative group structure emerged, and then variations were often tried before the group settled into an equilibrated role structure (see also Gersick and Hackman's [1990] discussion of habitual routines in groups).

Groups may differ in how long they take to achieve stability, but once stability is achieved, further change is commonly viewed as requiring external intervention. Robust equilibrium models are

implicit in much small group research that compares early and late periods, or that contrasts structural elements that develop at different speeds. The presumption (often not articulated) is that once a group has emerged from its early period and finished settling, the structure of interest will stay relatively constant.

Punctuated equilibrium models. The theory of punctuated equilibrium, originally developed to describe biological evolution (Eldredge & Gould, 1972), was applied first to organizational theory (e.g., Tushman & Romanelli, 1985) and then to small groups (Gersick, 1988). In the process, it shifted from a theory about change in populations to a theory about change within entities. The common feature is in the observed pattern of change—periods of stasis (or in some versions, incremental change) punctuated by short periods of radical change in which a group attempts to improve its fit with the demands of its embedding context.

Gersick (1988) found that groups quickly established a stable structure, which persisted until the midpoint of their time together, at which the groups reorganized and established a new stable structure. During the first stable period, progress on the group task was relatively slow. During the second stable period, the project groups worked more effectively and achieved their goals and objectives. More general punctuated equilibrium models (Arrow, 1997; Gersick & Hackman, 1990) propose a pattern of longer stable periods punctuated by sudden, discontinuous times of instability and reorganization. Whereas change can be triggered by either internal or external forces, stability is seen to be maintained by processes internal to the group. The model combines evolutionary and teleological motors (Poole et al., 2000).

Adaptive response models. These models emphasize response to environmental opportunities and constraints as a guiding force in group change and continuity (Arrow, 1997). Developmental patterns are seen as contingent on the forces and incentives available to each group (McGrath, 1991), leading to idiosyncratic patterns of development across groups, depending on whether the relevant embedding context is relatively stable or dynamic. The primary

motor is teleological, as groups are seen as purposive entities pursuing a variety of goals. These models incorporate the notion of equifinality, which means that many paths can lead to the same destination. Time, interaction, and performance theory (McGrath, 1991) proposes that groups typically pursue multiple concurrent projects related to three functions: task performance, member support, and group well-being. The sequence of transitions from different modes of activity will differ based on the nature of projects and obstacles a group encounters.

TEMPORAL PATTERNING IN GROUP PROCESS

Work reviewed in this section focuses on patterning across shorter time scales than the lifespan of group development, often attending to a particular thread of group activity or group structure. We adopt the convention suggested by McGrath & O'Connor (1996) of distinguishing between the developmental stages of the previous section and phases of an activity cycle.

Patterning task activity within and across task cycles. Some of the earliest research on phase sequences was conducted by Bales and his colleagues (Bales 1950, 1953; Bales & Strodtbeck, 1951). After observing numerous laboratory groups, they described decision-making groups as moving through three phases, orientation (in which the problem is discussed and the group organizes itself), evaluation (in which the members consider alternatives and sometimes engage in conflict), and control (in which the group centers on one option and attempts to take action). This phase model, like stage models in group development, assumes a life-cycle change motor—the unfolding of a sequence—this is either logically determined or imposed on the group.

Later descriptive work provided evidence that groups do not necessarily follow a single fixed sequence of phases. Poole and colleagues (Poole, 1981; Poole & Roth, 1989) and Hirokawa and colleagues (Hirokawa, 1990; Orlitzky & Hirokawa, 2001) found that groups follow many decision paths. Normative prescriptions have also been adjusted: Although Hirokawa and colleagues found that

some decision paths are better than others, no single sequence of phases is "best." Instead, many temporal patterns of decision making led to the same end result: good performance. The path chosen may depend on task features such as problem complexity (Nutt, 1984). Over the decades, work has thus shifted away from looking for the single best path to proposing that adapting activity patterns to match the task and contextual demands is essential to effective group performance (e.g., Ancona & Chong, 1996; Poole & De Sanctis, 1990). This indicates a corresponding shift to a more teleological focus on purposeful movement toward a goal, with changes inspired by feedback from the environment.

Researchers have also divided conflict interaction and negotiation into sequential periods with different behavioral patterns (Folger, Poole, & Stutman, 2000). Sheppard's (1984) phase analysis identified a four-step process as groups resolve conflicts. In the first three steps, group members develop a joint definition of the issue at hand, then move to a discussion of the alternative settlements, and finally select an alternative. The fourth phase is a period of reconciliation to the settlement. An alternative approach to defining phases focuses on the changing intensity of the conflict itself. Glasl (1982) describes the range of escalatory levels possible. At the first phase or level, parties are aware of tensions but try to handle them in a reasonable, controlled way. In the second phase, the relationship between the parties becomes the main source of tension and is characterized by distrust and lack of respect. At the third and highest phase, confrontations become aggressive and destructive. Glasl asserts that conflicts escalate from one phase to the next when parties pass an unspecified threshold of progressively extreme behavior. At higher levels, new dynamics emerge that make de-escalation very difficult.

Scholars interested in groups tackling problems or projects that are broader than a particular decision or conflict have also generated both descriptive and normative models. A standard proscription is that groups should begin with an *orientation* that serves as an anticipatory function—identifying goals and developing a plan to reach them. Next, the group should *enact* the plan. As the plan is executed, the group should *monitor* the results of its actions.

Results should be compared to those anticipated by the plan, and the group should determine if their action has moved them closer to attaining the goal. If not, the group should *modify* the plan accordingly (Tschan, 2002). This pattern of orient-enact-monitor-modify (McGrath & Tschan, 2004) is an information-processing model that sees change as teleological.

Empirical studies indicate that groups do not reliably follow this pattern and appear particularly reluctant to spend time planning before leaping into action (e.g., Hackman & Morris, 1975; Weingart, 1992). In line with normative prescriptions, groups that do plan ahead tend to perform better (e.g., Harper & Askling, 1980; Wittenbaum & Stasser, 1996). However, as with the decision-making literature, some suggest that the applicability of normative sequence rules may depend on context and task. In a static environment, taking time to gather information and consider alternatives makes sense. In a changing environment, it may be better to just act and see what happens, adjusting in "real-time" rather than planning (Eisenhardt & Sull, 2001).

Some scholars have looked at temporal patterns of group performance at longer sequences and noted changes across cycles, such as cumulative improvement, progressive decline, or more complicated patterns of change. An example of progressive decline is groupthink (Janis, 1982). The more a group afflicted with groupthink invests in a poor course of action, the more committed it becomes, piling bad decision on bad decision. Groupthink develops when groups fail to properly evaluate alternatives and monitor the impact of decisions. In other words, the orient and monitor steps of the orient-enact-monitor-modify model (McGrath & Tschan, 2004) are omitted or not executed properly.

Yet, performance spirals can go in either direction. Initial success or failure can lead to both upward and downward performance spirals across multiple task cycles (Lindsley, Brass, & Thomas, 1995). In these spirals, group self-efficacy and performance increase or decrease in tandem through an amplifying positive feedback loop, in contrast to the pairing of inflated confidence and disastrous performance typical of groupthink. Second-order changes can occur when an efficacy-performance spiral reverses

direction, is stopped though self-corrective action by the group, or ends because of ceiling or floor effects. Lindsley and colleagues (1995) explicitly distinguish these spirals from learning curves, a different kind of cumulative change pattern.

Although group performance on a new task can be expected to improve over successive task cycles simply on the basis of individual learning, group-level learning can also contribute to improvement (Argote, 1993). Prior individual experience (and associated learning) does not necessarily transfer to a group (e.g., Tuckman & Lorge, 1962), whereas group training does improve subsequent performance (Moreland, 1999), evidence that group-level processes, such as improved coordination and the development of transactive memory systems, are involved. The shape of group (and organizational) learning curves appears to be less consistent than individual learning curves, however, and some groups fail to show any improvement (Argote, 1993).

Emergence and stabilization of new structure. The development of structure in groups involves both the convergence of members on shared beliefs or behaviors and the divergence of members as they sort out into differentiated roles or status positions in the group. One consistent thread that runs through work on temporal aspects of structure is the contrast between fast and slow rhythms of emergence and stabilization.

Opp's (1982) norm formation theory distinguishes between the fast, top-down adoption of norms via what he calls "institutional" norm formation and the slower, more gradual, implicit process of "evolutionary" norm formation. The third route is explicit discussion and negotiation ("voluntary" norm formation), which may happen early in the life of a group or when a new issue not handled by existing norms surfaces. Bettenhausen and Murnighan (1985) also envision slow and fast processes, although they focus on whether, at their initial interaction, members retrieve the same or different "scripts" for behavior, and whether the scripts match.

Expectation-states and dominance theorists (Sell, Lovaglia, Mannix, Samuelson, & Wilson, 2004 [this issue]) propose that demographically diverse groups (see Ridgeway, 1984) make status

distinctions very quickly based on the surface characteristics of members that are more salient in newer groups (e.g., race, gender, age). In more homogeneous groups, however, these distinctions are proposed to emerge as the group interacts and members evaluate the relative quality and volume of member contributions to the discussion (Bales, Strodtbeck, Mills, & Roseborough, 1951). Not all homogeneous groups, however, demonstrate this "slower" pattern of differentiation. Fisek and Ofshe (1970), for example, found that a clear and persistent status differentiation was evident from the start in about half of the groups in their study.

Social role theory (Eagly, 1987) predicts that in demographically diverse groups, status and roles will be initially assigned according to stereotypes, following the same line of reasoning as expectation-states theory. However, as members get to know each other better, individuating information will cause members to adjust inaccurate assessments and reassign roles and status accordingly. Case studies indicate, however, that perceptions of performance tend to be distorted in ways that confirm the existing social order so that these adjustments do not necessarily take place. In the Robbers Cave study, for example, boys consistently overestimated the performance of high-status members and also tended to underestimate the scores of low-ranking members (Sherif, 1966, p. 77). This stabilizes and perpetuates the established hierarchy. The prediction that the impact of surface characteristics of members should fade over time while the impact of deeper characteristics such as attitudes and values increases (see Moreland & Levine, 1992) has, however, also garnered some empirical support (e.g., Harrison, Price, & Bell, 1998).

Cohesion, which holds a group and its members together, is commonly viewed as resulting at least in part from mutual attraction between group members. This attraction also has fast- and slow-developing elements. Cohesion based on social attraction forms quickly, as it involves simple attraction to a group prototype (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Cohesion based on interpersonal attraction forms more slowly, as it involves an emergent mesh of feelings as members get to know each other (Hogg, 1992).

Habitual routines develop quickly in most groups, and, according to standard accounts (e.g., Gersick & Hackman, 1990), are hard to change later on. Although rational models of orient-enact-monitor-modify indicate that groups should alter their behavior whenever feedback indicates they are not progressing expeditiously toward their goals, in practice, groups often cling to ineffective routines. Stabilized routines seem to turn off the teleological motor of goal-directed change, except during occasional windows of opportunity during which the group is more open to intervention (Hackman, 2002). External time pressure, like a looming deadline, may disrupt routine task execution (e.g., Gersick, 1988). Feldman (2000) challenges the standard view of habitual routines as changing mainly in response to a crisis, external shock, or intervention. She suggests that organizational routines, like other structures, are constantly being adjusted and altered based both on exogenous feedback and endogenous processes.

What forces stabilize group structures and make them resistant to change? Balance theory (Heider, 1958) proposes that balanced pairings of dyads create stability, whereas unbalanced pairings, in which, for example, I dislike the friend of a friend, are inherently unstable. In an early study of emergent friendship cliques, Newcomb (1961) used balance theory to explain how, as high-attraction dyads became linked together in triads, the reinforcement of existing shared attitudes among larger numbers of people made change increasingly unlikely. Three decades later, Carley (1991) proposed that stability is maintained by the reinforcing nature of interaction on shared member knowledge structures, which in turn reinforces similar future interactions. Kelly (1984) used the concept of entrainment to explain why routines are resilient. As group members become entrained to each other and to contextual demands, a change in routine requires more than just one individual's deciding to change. Instead, multiple group members must not only decide to change a routine, but they must decide together how to change it for the group to maintain its function.

Ongoing adjustments, instability, and discontinuities. Most theorizing and empirical research on structure focuses on the initial

emergence of structure, emphasizes the stability of that structure, and pays little attention to later changes. In this section, we consider work that attends more to ongoing adjustments and discontinuities. We focus in particular on patterns of continuity and change in group composition and member-group relationships.

The group socialization model (Moreland & Levine, 1982) identifies both the transitions members go through as they are socialized (and in some cases, resocialized) into their groups and the dynamic mechanism underlying these changes. The mechanism is an ongoing mutual evaluation process between group and member, which determines both the member's commitment to the group and the group's commitment to the member. During the *investigation* phase, a prospective member searches for a group to satisfy personal needs, and the group searches for members who can help achieve its goals. If mutual commitment between the group and the prospective member increases past a certain threshold, the individual becomes a new member. During the ensuing *socialization* phase, the new member and the group engage in a dialectic of accommodation and assimilation as they try to elicit changes that will improve the attractiveness of the member to the group and vice versa. If commitment increases to the next threshold, the group accepts the person as a full member. Role renegotiation can continue during the *maintenance* phase, as member and group needs change over time. Problematic negotiations result in divergence, and the now marginal member enters *resocialization*, during which the member and the group try to negotiate changes that restore commitment to full membership levels. If negotiations fail, the member may exit or be expelled, leading to the *remembrance* phase (see Moreland & Levine, 2000, for a review of research generated by this model).

Membership dynamics theory (Arrow & McGrath, 1995), which complements this model, proposes that groups always experience pressures both toward continuity and toward change. Changes in membership may result from endogenous processes, as envisioned by the group socialization model, or from exogenous forces, such as members being fired, reassigned, or added to the group by powerful outsiders. Such changes destabilize the group

structure and require a series of adjustments, which can bring a mixture of positive and negative effects.

Comments. The overall historical progression of much work on change processes exhibits a shift from early descriptive work to normative work on best sequences or patterns, and thence to a series of findings that call into question both the earlier descriptive models and the prescriptions of the normative models. Just as groups at the whole system level appear to change over time—but not necessarily in the same way, or at the same rate—temporal patterns in group interaction and task activity appear to differ across tasks, across groups, and also across apparently similar groups doing identical tasks. A coherent story of how and why that accounts for the many exceptions and contingencies is yet to emerge.

The general tendency in group research, as in most social science, has been to search for simple, straightforward patterns and theories. Seen as a whole, however, the accumulated findings on change in groups seem to be pushing us in the opposite direction. The complexity of observed patterns is increasingly clear. What is much less clear is what to make of these complexities. We turn next to work that attempts to grapple directly with complex dynamic patterns as a fundamental feature of small groups.

GROUPS AS COMPLEX SYSTEMS: AN EMERGING PERSPECTIVE ON GROUPS

Theories and research that treat groups as complex systems share a set of assumptions:

- Groups are influenced by a multitude of factors that interact in non-linear fashion. Some theories assume these interactions are constituted by human action, which is inherently nondeterministic; others focus on recursive interactions that may follow simple rules.
- Group systems are composed of multiple levels both within the group and between the group and its environment, and cross-level influences are complex and nonlinear.

- Group systems are not always "well behaved." Instead, they are often unpredictable, with behavior marked by discontinuities, critical incidents, path dependence, novelty, multiple causal factors operating unevenly on different levels and at different times in the group's history, and causal factors running on substantially different time scales.

Beyond these common points, there is a good deal of diversity among complex systems theories of groups. Some are cast primarily in traditional, propositional terms, whereas others offer mathematical and simulation models. We describe selected examples below.

PROPOSITIONAL THEORIES OF COMPLEX GROUP SYSTEMS

Theories expressed in propositional formats including action systems theory (von Cranach, 1996), complex systems theory (Arrow et al., 2000), complex action systems theory (an integration of the first two theories, McGrath & Tschan, 2004, in press), bona fide group theory (Putnam & Stohl, 1996), and structuration theory. In this section, we will focus on structuration theory and complex systems theory.

Structuration theory (Poole & DeSanctis, in press; Poole, Seibold, & McPhee, 1996) considers how group activities are constituted through members' actions. It rests on a distinction between system, the observable pattern of relations in a group, and structure, the rules and resources members use to generate and sustain the group system. Structuration theory construes the observable group system as a set of practices constituted by members' structuring behavior. For example, a researcher using structuration theory would explore conflict management by asking questions such as What rules and resources enable and guide conflict management? and Does group interaction give rise to other structuring processes that counteract or undermine the conflict management? Structurational research searches for a hidden order of structures and structuring processes underlying the observable group.

The central concept in the theory is structuration, which refers to the processes by which systems are produced and reproduced

through members' use of rules and resources. This definition rests on several key arguments. First, not only is a system produced and reproduced through structuration, but the structures themselves are, too. Structures are dualities: they are both the medium and outcome of action. They are the medium of action because group members draw on structures to interact. They are its outcome because rules and resources exist only by virtue of being used in a practice; whenever a structure is employed, the activity reproduces it by invoking and confirming it as a meaningful basis for action. For instance, when a group takes a vote, it is employing the rules behind voting to act, but it is also reminding itself that these rules exist, working out a way of using the rules, and perhaps creating a special version of them. By voting, the group is producing and reproducing the rules for present and future use. Hence, structures have a virtual existence; they exist in a continuous process of structuration.

Structures are sometimes created from scratch, but more often, groups appropriate them from existing institutional structures. Majority voting schemes, for example, are used throughout democratic societies and are embodied in formal rules of many committees, so it is not surprising that members of groups carry this structure with them to other groups. The appropriation process, an important focus of research, may lead to structural innovation and change.

Two classes of factors influence structuration. The first class includes characteristics of the group and its situation, such as the group's tasks and the structures available in relevant institutions; members' degree of insight into the structures and the system as a whole; differential distributions of resources, which create power and status distinctions; and the unintended consequences of action, which arise as a result of the complexity of group systems and their environments. The second set of influences on structuration is the dynamics through which different structural features mediate and interact with each other.

Structuration theory has been applied in the study of argument and influence in groups (e.g., Poole et al., 1996), group use of information technology (e.g., DeSanctis & Poole, 1994), and jury deci-

sion making (Keogh & Lake, 1993). It attempts to mediate the tensions in group research between action and structure, micro- and macrolevels of analysis, and the group and its environment. It argues that complexity is a function of different ways in which structuring processes play out in particular contexts.

The groups-as-complex-systems framework (Arrow et al., 2000) adapts ideas from complexity science to create an account of groups as open, adaptive systems. These systems interact with the component systems (the members), who are partially embedded within them and with the multiple larger systems (organizations, neighborhoods, societies, economies) in which they are embedded. Collective group behavior emerges out of the interactions of group members, and this behavior evolves over time based in part on the constraints of the group's embedding contexts. The study of groups should thus attend to at least three levels of causal dynamics: the local dynamics of group interaction (where individual rhythms become entrained), the global dynamics of group development and change over time (where large scale rhythms are apparent), and the contextual dynamics of changing environmental constraints and group responses to these constraints (Arrow et al., 2000).

Group structure is envisioned as a matrix of networks in which connections between members, tasks, tools, and information are established, enacted, monitored, and modified over time in response to changes in task, context, and experience. Group behavior is guided by the demands of group projects and member needs, and success in addressing these (sometimes conflicting) demands affects the viability and integrity of the group as a system.

Complex systems are hierarchically organized from more local to more global levels, and ordered behavior in such systems is generated and maintained by repeated nonlinear interactions between components (members), a process called self-organization. The nature of nonlinear interaction means that even if group members follow simple rules of interaction, the details of their interactions cannot be predicted, and efforts to make such predictions are futile, like trying to predict the amount of rainfall in a particular square mile a week in advance. Collective behavior, however (such as storm systems or groups), exhibits regularities that are much sim-

pler than these myriad local interactions. This approach asserts that groups can best be studied by focusing on the evolution of group behavior, rather than trying to build up an understanding by the patient accumulation of detailed knowledge about individual members, about the complex array of attributes, beliefs, and attitudes that members hold, and then trying to figure out how they might all interact. It proposes that many emergent patterns of group behavior should be independent of the characteristics of individual group members, although they may vary systematically, depending on constraints in the system's environment.

When system constraints (or contextual variables, Arrow et al., 2000) differ across groups or change during the lifetime of a single group, this can trigger a shift to qualitatively different patterns (for example, from repeating cycles to chaotic behavior), although some changes in contextual variables will trigger such bifurcations and others will not. The impact of contextual variables on global behavior is not linear: Large changes at some ranges of values will have no discernable effect, whereas small changes at some other ranges of values (near critical thresholds) will have dramatic effects on the group. Identifying the thresholds at which abrupt changes are likely should help us design more effective interventions.

Complexity principles applied to the study of groups thus suggest a number of propositions, including the following:

- Interactions between group members should give rise to global patterns of behavior that cannot be deduced from studying individual member behavior.
- A relatively small number of characteristic developmental patterns should be apparent among groups operating in similar conditions, although the details of how these patterns unfold (i.e., actual levels of variables, frequencies, and pacing) will vary between otherwise highly similar groups. Different constraints in the group's operating environment will also be associated with different characteristic patterns of development.
- Groups will sometimes jump from one pattern to another in response to a change in operating conditions, but the occurrence of this response will depend on where in the range of contextual variables the change occurs, not on the size of the change.

FORMAL MODELS OF COMPLEXITY IN GROUPS

Formal modeling has a long history in group research. Examples of mathematical dynamic models include Fisek's (Berger, Conner & Fisek, 1974) model of the evolution of status structures in groups and James A. Davis's (1967) models of balance in small groups and cliques. Simulation models take a different approach, replicating the sequence of activities an individual or group undertakes rather than just calculating values of coevolving variables. Some simulations are mathematically based, such as Stasser's (1988) DISCUSS model, which simulates information flow and effects during group discussion or Hastie, Penrod, and Pennington's (1983) JUS model, which simulates jury decision making. Another simulation option is cellular automata, which represent how interconnected units influence each other over time. Latané (1996) and colleagues (e.g., Nowak, Szamrej, & Latané, 1990) have used cellular automata to model the spread of ideas, emotions, and behaviors through a system. A third approach is systems dynamics simulation, used by Contractor and Seibold (1993) to develop and test a self-organizing systems model of structuration processes in computer supported groups.

**COMMONALITIES AND DIFFERENCES
IN COMPLEXITY APPROACHES**

The connections between the lines of work discussed in this section are obvious, but there are also clear differences between them. They differ, first, in whether they are stated in verbal or formal terms. The structuration and complex group systems approaches presume that human action is sufficiently complex that it cannot be fully captured by formal models. Formal modeling approaches, in contrast, attempt to capture relatively simple underlying rules of interaction that generate complex patterns, and look for qualitative similarities among these patterns, depending on the value of contextual parameters. The approaches also differ in their attitude toward complexity. Computational models presume that complexity emerges from simplicity and vice versa. Propositional theories treat complexity as a fundamental aspect of group life. Groups are

messy, these theories hold, precisely because human action is spontaneous and indeterminant, and because humans work with multiple levels of meaning, multiple projects, and are members of multiple groups.

PROSPECTS FOR TEMPORAL
PERSPECTIVES ON GROUPS

This body of literature reviewed varies in the nature of the theories and the extent to which theory guides empirical research. Some areas, such as group development, are rich in models but need more theoretical integration. We need a metaframework that incorporates multiple paths of development and seeks to identify the factors that predispose groups toward one path or another—or that can shift a group from one path to another. Models that apply to different time scales or types of activity—group development, decision development, group learning, performance spirals, and structuration and microlevel action cycles in conversation—could also benefit from better integration, so that we have a better sense of the ways in which temporal patterns evident at different time scales mesh with or disrupt one another.

We need theories that can account for the complexity that we observe. For behavior as complex as group interaction, it seems likely that an adequate theory will need to incorporate all four motors of change rather than focusing exclusively on a single motor, such as the teleological motor, while neglecting the operation of other forces. Of course, this will ultimately require an account of when, how, and why different motors of change become more or less important in the unfolding behavior of a group. We also need a better account of how groups maintain continuity in the face of changes in membership, task, and environmental context.

For large-scale temporal studies of groups to be feasible, we need to conduct theory-driven research with multiple groups operating under different task and contextual conditions, which suggests a shift from the individual-researcher model to more multisite, multischolar large-scale studies. The rewards should include

new insights into change processes, advances in theory, and a better understanding of the fundamental complexity of group interaction that gives rise to the mixed and often confusing results across many domains of small group research.

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