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Dynamics in Groups:
Are We There Yet?

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Abstract
We know that groups are dynamic entities, and yet we rarely study them as such. Previously hamstrung by limited theory, a decade of advances in understanding the fundamental nature of groups and change promised a revolution in group research. Our goal here is to review those theoretical developments and then examine their impact on our empirical understanding of group dynamics. Examining work done and not done, we will take stock of this work, identify the obstacles that seem to keep us focused more on group statics than dynamics, and then close by offering suggestions about not only what approaches to take

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when studying group dynamics, but also how the field can help develop these approaches. We hope that a review of the group dynamic literature in 2021 will celebrate our coming empirical accomplishments rather than lament a lack of them.

Introduction

Some 25 years ago, McGrath (1986) claimed that group research was focused on “group statics” rather than “group dynamics.”1 Around the year 2000, a number of leading group researchers took stock of the field (McGrath & Argote, 2001; Kozlowski & Bell, 2003; McGrath, Arrow & Berdahl, 2000) and concluded that dynamics were still missing from the study of groups. McGrath et al. (2000) in particular criticized the study of groups for using mostly “chain-like unidirectional cause – effect relationships” that did not account for the cross-level dynamics that occur in groups. Dynamics were described as follows (2000: 98):

Local dynamics involve the activity of a group’s constituent elements: members engaged in tasks using tools and resources. Local dynamics give rise to group-level or global dynamics. Global dynamics involve the behavior of system-level variables—such as norms and status structures, group identity and group cohesiveness, leadership, conflict, and task performance effectiveness—that emerge from and subsequently shape and constrain local dynamics. Contextual dynamics refer to the impact of system-level parameters that affect the overall trajectory of global group dynamics over time, and whose values are determined in part by the group’s embedding context.

Dynamics are challenging to study. If one focused primarily on the group level, then McGrath et al.’s (2000) description suggests that global (group-level) dynamics emerge from local (individual-level) ones, but are constrained by contextual ones (the environment in which a group operates). Thus, to study dynamics one must consider multilevel influence relationships. Such relationships may be recursive: individual elements can affect group-level properties, and group-level properties can also affect the individual elements.

Fortunately, around the time that McGrath and colleagues (2000) offered their critique, new methods for studying dynamics were being created. Tools for understanding what aspects of groups can change were being offered by those interested in multilevel constructs (cf. Chan, 1998; Chen, Mathieu & Bliese, 2004; Kozlowski & Klein, 2000). Tools for understanding how change happens were being offered by those interested in how groups evolve time (cf., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Marks, Mathieu, & Zaccaro, 2001). Tools for understanding time dependence (i.e., the effect of $X$ on $Y$ depends on the current state of the group) and recursion (i.e., $X$ can affect $Y$ at time 1, then $Y$ can affect $X$ at time 2) were being imported to management science from those who study system dynamics (cf. Sterman, 2000; Repenning, 2003). Such new conceptual tools should have invigorated the study of group dynamics; but did they?
Regrettably, they did not. In this review, we reach the same conclusion as the aforementioned authors have: dynamics are still largely missing from the study of groups. We found it puzzling that despite the existence of a clear need to study group dynamics and methods that would help in this endeavor, the study of group dynamics seemed to be languishing. As such, whereas prior reviews have not speculated why this is the case—Kozlowski & Bell (2003) say explicitly that they do not know why temporality is understudied—we attempt to identify key factors that contribute to the continued focus on “group statics.” Articulating these will provide additional guidance for how to break out of this habit, create new patterns and practices for group research, and make group dynamics a more common feature of group research. The ultimate result, we hope, will be higher-quality knowledge related to groups.

The paper has three sections. First, we review what group dynamics imply using the current conceptual/methodological advances that facilitate their study. Next, we see whether the advances discussed in the first section have diffused by reviewing group research published in 2010 in top journals. In taking stock, we highlight how the aforementioned advances can be used, as well as potential problems that are likely to arise if they are not incorporated into the practice of group research. Finally, we suggest changes for the way researchers approach the study of groups in general. These are critical because changing the practice of group research seems to require more than simple awareness of the problems with the current approach.

Groups as Dynamic Entities

Researchers (Hackman & Wageman, 2005; Mathieu, Maynard, Rapp, & Gilson, 2008; Mortensen, 2011) have examined group dynamics with respect to fluidity and change in the basic definitional aspects of groups (i.e., definable boundary, interdependent members, and shared fate; see Levine & Moreland, 1990). These authors have pointed out that group boundaries are often permeable, membership can be fluid, and a fate may be more or less shared by people who are members of multiple teams. Our focus is on the dynamic nature of group level phenomena—characteristics, processes, or properties that can be attributed to groups as entities. Such phenomena can evolve as the groups evolve, as can the relationships among group members. Our focus can be traced back to authors like Cartwright and Zander (1968), who highlighted how the study of groups must address the dynamics that produce developmental processes in groups while acknowledging that such dynamics are multilevel (i.e., they involve both the group as a whole and the individuals that constitute the collective). The recent work that can help us understand group dynamics relates to how we conceptualize group level phenomena (what is changing) and the ways in which these phenomena evolve over time (how change happens).
What is Changing: The Dynamic Profile of Group-level Constructs

Understanding how a group-level construct can change is the first step to understanding group dynamics, as “Team [or group] constructs and phenomena are not static. Many—indeed most—team level phenomena... emerge upwards from individual to the team level and unfold via complex temporal dynamics” (Kozlowski, Gully, Nason, & Smith, 1999: 242). But some aspects of groups are static, and not all group phenomena emerge upward via the same synthesis process. We therefore start by clarifying the dynamic profile of group constructs—the possible ways in which group phenomena can exist in relation to the synthesis processes that take place among the individual group members.

Constructs are conceptual abstractions of the particular phenomenon being studied (Ghiselli, 1964; MacCorquodale & Meehl, 1948). The “group-level” designation implies that the construct represents a phenomenon that should be attributed to the collective of individuals as opposed to any particular individual (Chan, 1998; Rousseau, 1985). As such, “explanatory reductionism”—that the behavior of the group construct can be explained by the properties of the constituent parts—is inappropriate (Hackman, 2003). A number of different researchers have written typologies that characterize the nature and properties of group level constructs (Chan, 1998; Chen, Mathieu & Bliese, 2004; Kozlowski & Klein, 2000). From this work, we can derive three distinct dynamic profiles: emergent, cumulative, and contextual. As we will argue, the same phenomena may be conceptualized as emergent, cumulative, or contextual; but categorizing them in this way puts different restrictions on the nature of the dynamics applicable to the phenomenon.

Emergent constructs. Emergent constructs are what Kozlowski et al. (1999) referred to in the above quotation. Emergence describes a process where a higher-level phenomenon comes into existence based on interaction among the lower-level elements (Holland, 1998; Morgeson & Hofmann, 1999). Most group phenomena studied in 2010 can be classified as emergent (for team member exchange, see Anand, Vidyarthi, Liden, & Rousseau, 2010; conflict, see Shaw et al., 2010; trust, see De Jong & Elfring, 2010; psychological safety, see Bunderson & Boumgarden, 2010; group identification, see Cooper & Thatcher, 2010). Some have argued that overall, most group phenomena are emergent (Ilgen et al., 2005; Kozlowski & Bell, 2003).

Although we typically examine emergent constructs at the group level, emergent phenomena are actually multilevel because they cannot exist without the individual interaction that creates them (Morgeson & Hofmann, 1999). Emergent constructs like transactive memory systems (TMS) (Liang, Moreland, & Argote, 1995) and shared mental models (SMM) (Klimoski & Mohammed, 1994) illustrate why. Neither exists independently of the individuals in the group. Emergence often takes time to occur, and can continue to
change over time. Using our examples, transactive memory systems arise in groups after people have experienced working together (Argote, Gruenfeld, & Naquin, 2001), and shared mental models can converge (Marks, Zaccaro, & Mathieu, 2000) or diverge (Levesque, Wilson, & Wholey, 2001) as groups work together on a task.

The synthesis process of emergence implies that the group-level construct is collectively created through interactions among the members. In this way, emergent constructs correspond to direct consensus and reference shift models (Chan, 1998; Chen et al., 2004) where group members’ interaction/beliefs collectively generate some identifiable shared property (e.g., trust, cohesion). However, as Kozlowski and Klein (2000) noted, the elemental contributions need not all be the same, nor does the property that emerges need to be isomorphic to the elements. Such is the case with transactive memory, where the members’ contributions are specialized and the property that emerges is different in function and form from the individual elements.

It is the synthesis process that makes emergent constructs the most dynamic. For the basic elements of emergence, the individual interactions and the attitudes/beliefs associated with them, are themselves dynamic. Moreover, across individuals or dyads these attributes can change at different rates (e.g., Jane may trust her teammates more quickly than John). All of these elemental variations will be reflected in changes in the group-level emergent phenomenon because of the tight coupling across levels (Morgeson & Hofmann, 1999).

So, for example, “role differentiation” could emerge in a self-managed team through the role identification behaviors (cf. Pearsall, Ellis, & Bell, 2010). It would take time for this to happen, and the role differentiation that emerges may continue to change over the lifespan of the group as members differentially engage their tasks, resources, and each other. But any change to these patterns of interaction changes the collective role differentiation.

**Cumulative constructs.** Cumulative constructs apply to group phenomena where the higher-level phenomenon is based in stable individual properties. These come into being when the boundary around a collective is drawn. There is not a synthesis function per se beyond the statistical summary deemed appropriate, such as a mean (the average amount of time members had worked in the type of team being studied; see Bresman, 2010), a sum (the number of “stars” on a team; see Groysberg, Polzer, & Elfenbein, 2010), a percentage (top management team [TMT] ownership of the firm; see Walters, Kroll, & Wright, 2010), variance (variance around how much conflict is perceived in a team; see Jehn, Rispens, & Thatcher, 2010), or a type of index (e.g., gender heterogeneity; see Wu, Tsui, & Kinicki, 2010).

Cumulative constructs, like emergent ones, are multilevel because the group property cannot exist independently of the individuals whose properties are cumulated. Cumulative constructs might be argued to “emerge” because they
only come into existence as a result of establishing a collective (e.g. diversity emerges once a boundary around the collective is drawn). This could be comparable to many physical analogies, such as the way temperature or pressure emerges based on the number of atoms in a space. However, Morgeson and Hofmann (1999) suggest that elemental interaction is what creates emergence. Cumulative constructs need no interaction or time to come into existence, and therefore have no emergence process.

Cumulative constructs yield a shared experience, but this shared experience is typically identified and characterized by the researcher identifying objective attributes (e.g., age, tenure, functional background); they are not created by the collective, they are pre-existing. In this way, cumulative constructs correspond to additive or dispersion models (Chan, 1998). Even when elements are not of the same type (e.g., individual ethnicities) or people have different contribution levels (e.g., individuals with differing levels of agreeableness), the level of difference characterizes what is shared by the group (Kozlowski & Klein, 2000). Whatever summary score characterizes the shared experience, there is no need to validate the construct by demonstrating agreement among team members (Chan, 1998; Chen et al., 2004).

Because cumulative constructs should not be sensitive to individual interaction (to keep them distinct from emergent ones), it is best when they are based in stable attributes of the individual elements (e.g., gender, IQ, years of experience, etc.). However, this also means that cumulative constructs are less dynamic than emergent ones. Because the individual-level aspects that create the cumulative group construct are stable, the cumulative construct will be relatively stable as well. For unchanging properties of individuals (e.g., gender, ethnicity, IQ), the only way for cumulative constructs to change is through membership change. For changeable properties (e.g., average tenure, age diversity, total experience), the change will have the same rate across members and is only a function of time. Such dynamics are slow and predictable.

Continuing our example, role heterogeneity could be a cumulative construct in a cross-functional team. Roles are typically tied to the functional backgrounds of the team members. People's functional backgrounds are relatively stable, and so the role heterogeneity of a team will not change unless the members change, or people retrain (a slow, independent process).

Contextual constructs. Contextual constructs apply to group properties that are imposed on the group by external forces. For example, an organization that dictates whether a group must have an even or odd number of members (Menon & Phillips, 2010), a specific task interdependence structure (Van der Vegt, de Jong, Bunderson, & Molleman, 2010), or level of resources (Skilton & Dooley, 2010) would all be creating contextual properties. Contextual properties can also be environmental conditions in which the group must operate,
such as a high degree of intergroup competition (Baer, Leenders, Oldham, & Vadera, 2010).

Contextual constructs have no synthesis function. They imply a shared experience that persists independently of dynamics within the group. Because of this, contextual constructs are not multilevel. This is why authors like Chan (1998) and Chen et al. (2004) did not include them as group constructs that were derived from the individuals in the collective. Contextual constructs thus have been described as “global” properties (Kozlowski and Klein, 2000) that are only group level. Thus if reward structure is dictated by management, it will not change as group members do. This is not to say that contextual constructs are fixed; it just says that they change as a result of influences outside the group. So, for example, team members may band together to get management to change their reward structure, but team member actions did not directly change the context-absent management intervention.

Because contextual constructs are insensitive to changes in the individuals who constitute the collective, they are the least dynamic. Indeed, absent external forces, contextual constructs characterize what it is about a group that is not dynamic. Continuing the comparison example, role heterogeneity in a team where the roles were defined by management (e.g., on an assembly line) would be fixed and should be conceptualized as contextual. However, contextual constructs can still play a role in group dynamics because they provide a top-down influence (Kozlowski & Klein, 2000) that may affect the way in which other internal dynamics unfold. So in our example of contextual role heterogeneity, trust may emerge differently under varying levels of role heterogeneity (e.g., the rate or trajectory of team evolution may change).

**Summary.** Embedded in prior classifications of group-level constructs (Chan, 1998; Chen et al., 2004; Kozlowski & Klein, 2000) are different dynamic profiles. Table 1 summarizes these. We clarified the dynamic profile of the construct types by articulating what is changeable in the individual level, and what this implies for change at the group level. This recategorization of construct types on the basis of their dynamic profile leverages the temporal aspects of existing work on level of analysis. Knowing the dynamic profile of a construct allows us to understand how it can be embedded in different kinds of temporal relationships. We turn to that next.

**How Change Happens: Group Evolution**

Change is both the result of a process and a process itself. Tuckman’s (1965) “forming–storming–norming–performing” is a classic example of change based on internal dynamics. While this example is a specific evolutionary process, it demonstrates the evolutionary aspects of group dynamics: groups retain and carry forward the effects of what has happened, individual and group level phenomena reciprocally influence each other, and the result of
Table 1  Dynamic Profiles of Construct Types

<table>
<thead>
<tr>
<th>Dynamic profile</th>
<th>Construct types typically in this category</th>
<th>Influence between individual elements</th>
<th>Synthesis of individual level attributes</th>
<th>Dynamic profile of group level property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contextual</td>
<td>Global (Kozlowski &amp; Klein, 2000)</td>
<td>No (group level)</td>
<td>NA</td>
<td>Fixed, but can moderate other intra-team dynamics</td>
</tr>
<tr>
<td>Cumulative</td>
<td>Additive, Dispersion (Chan, 1998)</td>
<td>Yes</td>
<td>No</td>
<td>Marginally dynamic—changes only with membership change or gradually with passage of time</td>
</tr>
<tr>
<td>Emergent</td>
<td>Direct Consensus, Referent-shift (Chan, 1998)</td>
<td>Yes</td>
<td>Yes</td>
<td>Highly dynamic—changes as interaction patterns/attitudes among members change</td>
</tr>
</tbody>
</table>
evolution can include both convergence (e.g., norming) and divergence (storming).

The path dependence of change. Marks et al. (2001) argued that the traditional IPO model of Hackman and Morris (1975) treated teams as existing in a kind of timeless condition, changing output based only on the processes enacted. As a result, they proposed a new IPSO model where the S corresponded to states that persisted over time until other processes changed them (e.g., the level of cohesion in a team should persist until something happens to increase or decrease it). P(rocesses) and S(tates) in the Marks et al. model were argued to have a reciprocal relationship. That is, processes, when enacted, could change the state (e.g., social interaction could increase cohesion) and the current condition of a state could influence how and which processes were enacted (e.g., in a group with very high cohesion, withdrawal is less likely to happen; but even if it does, the effect on the current level of cohesion may be muted). Ilgen et al. (2005) later generalized this to what they called the input–mediator–output–input (IMOI) model. This exchanged process/state distinction for a more general mediation mechanism: conceivably I, M, or O could be states or processes. The second I represents the beginning of the next evolutionary cycle. Effectively, IMOI implies IMOIIMOIMOI… Together, the Marks et al. (2001) and Ilgen et al. (2005) models suggest two features that must be considered to understand group dynamics: the first is memory, and the second is recursion.

Memory is the capacity for a system to retain the effects of past experience. Memory is embodied in the existence of states (which maintain their condition over time; Marks et al., 2001) or the idea that an output (O) at time 1 is an input (I) at time 2 (Ilgen et al., 2005). Individual memory is easy to understand, but groups also have memory repositories (routines, norms, manuals, databases; see Wilson, Goodman & Cronin, 2007). Memory introduces path dependence—i.e., that what can happen next depends on the current conditions.

Path dependence implies that the same phenomenon applied to the same group can have different effects depending on when it happens and what happened before. For example, Langfred (2007) found that the influence of a level of trust changed over time as the groups evolved in particular directions. Jehn and colleagues (Jehn & Bendersky, 2003; Jehn & Mannix, 2001) made similar arguments about conflict: specific types of conflict are more or less harmful, depending on when in a group’s lifespan it occurred. In these studies, the influence of the focal variable (trust or conflict) is dynamic because its influence depends on the prior history of the group. Averaging across time periods masks how a variable’s influence changes, and therefore can misspecify relationships (e.g., underestimating the effect size for new groups and overestimating it for established groups, or vice versa).
Reciprocal influence over time. The second feature of the Marks et al. (2001) and Ilgen et al. (2005) models that is necessary for understanding dynamics is recursion. Recursion is the possibility for causal chains to feed back upon themselves (i.e., to have a circular influence structure). In the Marks et al. (2001) model, it was the recursion between states and processes $(S_{t1} \rightarrow P_{t1} \rightarrow S_{t2} \rightarrow P_{t2} \ldots)$. In the Ilgen et al. (2005) model, it is the IMO loop. Recursion is embodied in one of the most basic dynamic “elements”—the feedback loop (Sterman, 2000). Feedback loops are critical for understanding dynamics because they work along with memory to make the behavior of systems nonlinear.

A clear demonstration of feedback loops and nonlinearity we borrow from Sterman (2000: Ch. 1). Imagine a system with eggs, chickens, and road crossings. The chickens and eggs are in a self-reinforcing feedback loop (more chickens means more eggs, which means more chickens, etc.), and so the growth of chickens happens exponentially. Chickens and road crossings are in a self-limiting feedback loop (more chickens means more road crossings, which means more chickens getting killed by cars, thereby reducing the number of chickens), and so the rate of growth decreases to an asymptote. Such self-reinforcing or self-limiting recursive relationships can also be found in groups. A conflict spiral (Brett, Shapiro & Lytle, 1998) is a kind of self-reinforcing feedback loop, while the increasing inattention to demographic characteristics as group members become familiar with each other (Harrison, Price, & Bell, 1998) is a self-limiting feedback loop. Whereas memory makes groups dynamic by inducing path dependence, feedback loops introduce nonlinearity and inertia into the trajectories of group evolution.

Whereas the Marks et al. (2001) and Ilgen et al. (2005) theories primarily provide insight into global dynamics (i.e. how group level $X$ can affect group level $Y$), to fully understand how groups evolve we must also consider feedback across levels and even within constructs. Multilevel feedback loops involve a group-level phenomenon ($G$) and individual properties to which the group-level phenomenon is sensitive ($\Sigma i$). Figure 1 displays feedback loops in

![Figure 1 The Structure of a Multilevel Feedback Loop in Traditional Systems Notation.](image)

Note: The left loop is self reinforcing. The right loop is self limiting.
traditional system dynamics notation. The arrows represent sequential processes whose level of influence can change over time, and G and/or $\Sigma i$ must have the capacity to retain the effects of past experience (i.e., memory). A display of this feedback loop over three periods of time using more traditional causal model notation can be found in Figure 2.

Multilevel feedback loops operate differently depending on the construct type (contextual, cumulative, or emergent). Contextual constructs are not part of within-group feedback loops, because they are insensitive to changes at the individual level. However, contextual constructs can moderate the way other multilevel dynamics take place (e.g., intergroup competition may alter the ease with which creativity emerges; see Baer et al., 2010). To examine how cumulative and emergent constructs can be embedded in feedback loops requires taking a systems perspective.

**Group Dynamics from a System Dynamics Perspective**

Cumulative construct G comes into existence immediately upon the assemblage of the individuals into a group [$\Sigma i \rightarrow G$]. The group-level phenomenon G that comes into being does not change the individual members’ properties; these are stable (G does not affect $\Sigma i'$). Cumulative constructs can change their

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**Figure 2  Feedback Over Three Periods.**

Note: $\Sigma i$ denotes the sum of individual attributes that generate group construct G; [$\Sigma i \rightarrow G$] represents a multilevel construct (cumulative or emergent); X represents an exogenous variable that has influence on the multilevel construct; each $'$ denotes the evolving state of the variables over time.
condition when membership changes, so it is possible that $G$ might influence some other group variable $X$ that produces turnover in the group. This type of feedback loop is represented in Figure 2 by the solid line connecting $X$ (the other factor) to the subsequent cumulative construct. For example, imagine that a company’s board of directors assembles a TMT and those people are all from the New York office. The location of these individuals ($\Sigma i$) imply that the team is co-located ($G$). No matter the team interaction, holding all else constant the cumulative phenomenon of co-location will remain. However, if the current co-location causes some concern by the members about a narrow perspective ($X$), some may exit the group and be replaced by others from different locations. This would change the $\Sigma i'$ and produce a corresponding change in $G'$ (a distributed team) at the next time period. The only other way cumulative $G$ changes when the individual-level construct $i$ has some kind of time dependence (e.g., $i = $ each individual’s years of experience in a particular industry, $G = $ the cumulative industry experience of the team, $X = $ time, therefore both $i$ and $G$ grow over time).

Emergent constructs can be in feedback loops with other constructs (e.g., cohesion [$G$] increases psychological safety [$X$], leading to more cohesion $G'$). But emergent constructs also have an internal feedback loop that allows them to evolve independently of other constructs. Both the individual aspects ($\Sigma i$) and the group aspect ($G$) are changeable and mutually influential in an emergent construct. The individual behaviors that generate the group-level property are themselves affected by the group-level property in the next time period. Social information processing theory (Salancik & Pfeffer, 1978) and social learning theory (Bandura, 1977) are two very general mechanisms that support such a claim, and would be applicable to the interactions, attitudes, and beliefs that comprise an emergent phenomenon. For example, conflict among individuals ($\Sigma i$) increases the level of conflict in the group ($G$) that is perceived by all group members, which can maintain conflict in those already involved while drawing others into the fray ($\Sigma i'$) (cf. Brett et al., 1998). This is depicted with the dashed line in Figure 2.

For example, the meta-analysis of the effects of team cognition (SMM and TMS) on group behaviors and performance explicitly defines team cognition as “a bottom-up emergent process” (DeChurch & Mesmer-Magnus, 2010: 35). If we think about SMM and TMS in two time periods, this conceptualization is adequate; at time 1, individuals have their mental models of the problem ($\Sigma i_{MM}$), which implies some level of sharedness ($G_{MM}$) that will persist to time 2 ($G_{MM}'$). Individuals interacting at time 1 discover each others’ expertise ($\Sigma i_{TMS}$), leading a TMS to emerge at time 2 ($G_{TMS}'$). But what happens at time 2? The SMM may reinforce task behavior, or learning who knows what reinforces individuals’ expertise, leading people to rely more heavily on the TMS to guide the search for and use of expertise (Austin, 2003; Jarvenpaa & Majchzak, 2008). This means that at time 2, the group-level emergent property
will shape individual interaction ($\Sigma i'$), reflecting an often ignored—but important—influence relationship from the emergent property back to the individual interaction from which it comes.

We rarely see within construct evolution, because the multilevel research methods literature sees emergence as a bottom-up process (Chan, 1998; Chen et al., 2008; Kozlowski and Klein, 2000; Morgeson & Hofmann, 1999). We speculate that emergent constructs are seen as bottom-up because the individual-level conditions are antecedent to the group-level emergent phenomena ($\Sigma i$ produces $G'$). However, this is a static view that ignores the recursive influence of the emerging group-level property on the individual level interaction that will occur at the next time period. Tying this back to the McGrath et al. (2000) quote we began with, it is not just that global dynamics emerge from local ones; it is that local and global dynamics can feed back upon each other within a single construct to create nonlinear growth. This is why we believe the systems approach should be incorporated into how we study teams.

Evolutionary states. We have been talking about the processes that underlie evolution. Yet we must also be able to think about how the structures and relationships of the individual elements reconfigure themselves as evolution takes place. Put differently, if an evolutionary process took place between time 1 and time 2, how would the group look different at time 2?

Kozlowski & Klein (2000) used a continuum of composition to compilation to describe the forms of multilevel relationships in groups, but it can also help us characterize the changes that can occur in groups as evolution is taking place. The most homogenous form they call composition, where the individual-level building blocks are similar (but not identical) in form and function to the group construct that emerges. For example, individual mental models are similar to team mental models that result from their aggregation, in that both are cognitive models of a problem and both function to help navigate and direct problem-solving efforts (see DeChurch & Mesmer-Magnus, 2010). When we think about compositional structures, we are really thinking about groups as vehicles that evolve toward similarity and convergence.

However, Kozlowski and Klein (2000) pointed out that the synthesis relationship between individual elements and the group phenomena they produce exists in more varieties than the simple isomorphism of composition. Elements can vary in their types and their function, and the nature of what arises may be quite different in character from the elements that produce it. They characterized these forms on a continuum of increasing compilation, where the individual-level building blocks become increasingly heterogeneous in form and function, and the group-level construct that emerges looks more distinct from any particular individual-level element. Transactive memory is an example of the highest level of compilation (De Church &
Mesmer-Magnus, 2000); individual elements are specialized and coordinated, and the TMS that emerges is structured and functions differently from any of the elements that constitute it.

The underlying principle of the composition–compilation continuum is that the change induced by the group milieu does not always make individual elements more similar. This is critical for understanding dynamics. Memory and feedback create the causal chain that explains group evolution, but the structures that emerge from this evolution are somewhere on the composition–compilation continuum. For simplicity we want to focus on one key aspect: the degree of differentiation among elements and between levels that evolves.

Kozlowski & Klein (2000) describe three forms where individual elements yield a similar group-level effect (using our notation from Figures 1 and 2, i and G are similar in function and form). *Composition* implies that the degree to which i contributes to G is equal across individuals, and *pooled constrained/unconstrained compilation* both imply that i is variable (e.g., people vary on the degree to which they contribute to the emergent group potency). These all imply a kind of convergence trajectory in group evolution. Differentiation is a property of *variance compilation* and *patterned compilation*, with the latter the most differentiated (Kozlowski & Klein, 2000). Variance compilation shows differentiation between the group-level effect and the individual elements that constitute it (e.g., individuals are not by themselves diverse, but together they create a level of diversity in the group), or in the focal aspects among the individual elements (e.g., being concerned with how much deviation from the group average there is as opposed to the level of that average). Differentiation is highest in patterned compilation. Not only are the individual elements distinct in their properties and/or roles, but the group phenomenon that emerges is also distinct from the individual elements that create it. Understanding that evolution can produce differentiation rather than just convergence is critical to seeing the full spectrum of evolutionary pathways.

**Summary.** Authors have provided new ways to conceptualize how groups evolve over time. These highlight the way groups should treat historical dependencies as well as reciprocal relationships (Ilgen et al., 2005; Marks et al., 2001). Pushing further, the system dynamics perspective (cf. Sterman, 2000) allows us to think about reciprocal relationships in more fine-grained ways, such as across levels and within constructs. Finally, Kozlowski and Klein (2000) highlight how group evolution can increase differentiation, not just homogenization. Table 2 juxtaposes the points about how evolution occurs with the dynamic profiles of what changes that we reviewed in the prior section. Attention to at least some of these issues should be present in group research if it is to increase knowledge about groups as dynamic entities. Is it?
Taking Stock of Dynamic Relationships Evident in the Groups Literature

The idea that groups have time-dependent relationships that occur at multiple levels of analysis (Sundstrom, de Meuse, & Futrell, 1990; McGrath et al., 2000), for different team functions (e.g., mission analysis or system monitoring; see Devine, 2002), and with different cadences (Ancona, Goodman, Lawrence & Tushman, 2001; Marks et al., 2001; Argote & McGrath, 2001) is longstanding (Cartwright & Zander, 1968). That group research needs to incorporate these but does not is also a common refrain in these and other (Kozlowski & Bell, 2003) papers. Did the subsequent conceptual advances relating to group dynamics that we have reviewed invigorate the study of group dynamics? We examined how groups are being studied in the most recent literature—that which was published in 2010—to find out.

Table 2  Dynamic Profiles in Relation to Dynamic Features

<table>
<thead>
<tr>
<th>Dynamic features</th>
<th>Contextual constructs</th>
<th>Cumulative constructs</th>
<th>Emergent constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory that induces path dependence</td>
<td>Fixed, embedded in the context</td>
<td>Stable, embedded in individual properties</td>
<td>Variable, embedded in habit and routine</td>
</tr>
<tr>
<td>Reciprocal influence</td>
<td>None</td>
<td>Between construct</td>
<td>Between construct, within construct across level</td>
</tr>
<tr>
<td>Maximum differentiation potential</td>
<td>None—all members are in same context</td>
<td>Moderate—members may differ, but the group level construct is somehow “the sum of the parts”</td>
<td>High—members may differ, and the group level construct that emerges may more than the sum of the parts</td>
</tr>
</tbody>
</table>

Taking Stock of Dynamic Relationships Evident in the Groups Literature

The idea that groups have time-dependent relationships that occur at multiple levels of analysis (Sundstrom, de Meuse, & Futrell, 1990; McGrath et al., 2000), for different team functions (e.g., mission analysis or system monitoring; see Devine, 2002), and with different cadences (Ancona, Goodman, Lawrence & Tushman, 2001; Marks et al., 2001; Argote & McGrath, 2001) is longstanding (Cartwright & Zander, 1968). That group research needs to incorporate these but does not is also a common refrain in these and other (Kozlowski & Bell, 2003) papers. Did the subsequent conceptual advances relating to group dynamics that we have reviewed invigorate the study of group dynamics? We examined how groups are being studied in the most recent literature—that which was published in 2010—to find out.

Article selection and coding method

We identified 55 articles on groups/teams published in 2010 in top management journals (AMJ, AMR, ASQ, JAP, OBHDP, and Organization Science). Examining 2010 publications provides the most time for dissemination of the reviewed conceptual advances. Using the search engines associated with the publishers of the respective journals, we retrieved articles that used “group” or “team” as a keyword anywhere. From this initial set, we extracted the final set if (1) the relationships being presented were original (i.e., not meta-analyses or commentaries) and (2) at least one of the independent variables was conceptualized at the group level.

Empirical articles in our sample contained between one and four studies. We coded each study as: cross-sectional—all relationships characterize a
team at one point in time; treatment outcome—the dependent variables are measured after some event or manipulation in a controlled setting; or longitudinal—at least one relationship is measured across points in time. Theoretical articles were treated as one study. Theoretical articles were longitudinal if there was explicit reference to temporal issues, and cross-sectional otherwise.

The 55 articles contained 286 group-level (per authors’ designation) constructs. Specific constructs were counted once per article (i.e., group identity is counted once in an article with four lab studies on it). We coded all constructs for whether they were independent variables, control variables, or dependent variables using the authors’ designations. We also coded whether a construct was treated as contextual, cumulative, or emergent. As per our above discussion, contextual constructs were imposed by either the experimenter or a force external to the team, and do not change based upon anything at the individual level from within the team. Cumulative constructs were based in properties of the individuals that are either fixed or change at a constant rate and are insensitive to variation in the interaction patterns of the group members. Emergent constructs were based in changeable properties of the individual or their interrelationships. We also noted if a construct was validated, and the method used.

For cumulative and emergent constructs where individuals’ contribution to it was distinguishable, we coded the differentiation in the evolving state. Convergent constructs were those where similar individual elements performed similar functions in producing the group-level construct, and there was homology across levels (i.e., Kozlowski & Klein’s [2000] composition, pooled constrained compilation, and pooled unconstrained compilation). Differentiation was coded at two levels. Variance compilation constructs had differentiated individual elements that aggregate predictably to produce the group level construct, while patterned compilation constructs had differentiated individual elements that are specialized and coordinated to produce a functionally distinct group level phenomenon (Kozlowski & Klein, 2000).

We coded whether the cumulative or emergent constructs were positioned in a feedback loop. Constructs were coded as being in a between-construct feedback loop if the constructs was part of a causal chain that was circular, no matter the length (e.g., $X \rightarrow Y \rightarrow X \ldots$ or $X \rightarrow Y \rightarrow Z \rightarrow X \ldots$). For emergent constructs, we coded if there was explicit consideration of the within-construct multilevel feedback loop ($\Sigma i \rightarrow G \rightarrow \Sigma i' \ldots$, as in Figure 2).

General Trends in Recent Literature on Teams

Table 3 presents a cross-categorization of the construct types by their roles in the 2010 studies. We identified four general trends in this research. First, few studies examine groups over time. Second, among those studying groups over time, most still test unidirectional cause–effect chains. Third, among those studying cumulative or emergent constructs, the evolution implied is
still primarily about convergence. Fourth, studying how group dynamics are affected by context is underrepresented. We explain these trends, but we also offer examples of those studies that go against these trends to illustrate how such problems might be remedied.

**Groups over time—still underrepresented.** Of the 55 total articles we reviewed, few explicitly considered change over time. Of the seven theoretical articles—including Fang, Lee, & Schilling’s (2010) simulation—five explicitly considered temporal dependency, and as such were amenable to longitudinal study. The remaining 48 empirical articles contained 65 individual studies. Of these 65 studies, only 17 (26%) were longitudinal. Of the remaining studies, 24 were treatment outcome (37%) and 24 were cross-sectional (37%). Theory seems to lead empirical work in terms of considering group phenomena over time (71% vs. 26% longitudinal studies).

The theory proposed by Ashforth, Rogers, & Corley (2010)—that individual identities merge into group identities, which then become assumed reality—demonstrates how theory can incorporate dynamic change over time. Identity is nested across levels of analysis, and these levels influence each other reciprocally. The methodology needed to test such nested and reciprocal relationships would have to be sophisticated, and would likely be difficult to implement (a point we return to later). This difficulty might explain why empirical papers lag behind theoretical ones in testing dynamic models. Theory papers that provide guidance for how to test the dynamics of their proposed relationships might lessen the burden on the empirical researcher.

The type of study employed is a fundamental concern for group dynamics. Dynamics cannot be understood cross-sectionally. Treatment-outcome designs can be expanded to longitudinal designs, but lab research rarely does this. Two longitudinal research papers used case studies (Clark, Gioia, Ketchen & Thomas, 2010; Zietsma & Lawrence, 2010). Each study examined a small number of groups, either in a particular organizational (Clark et al., 2010) or institutional setting (Zietsma & Lawrence, 2010) as they underwent a change process. Qualitative research such as case studies may be particularly useful for understanding dynamics. As Edmondson and McManus (2007) argued,
when little is known about a phenomenon, qualitative work is most informative. And despite the fact that much is known about team phenomena, little is known about how these phenomena evolve and change over time.

There are examples of longitudinal work in quantitative, empirical settings that can be used to inform knowledge of group dynamics. Goncalo, Polman, and Maslach (2010) studied student teams, measuring variables at five points in time. Their study provided a longitudinal examination of how collective efficacy changed across the lifespan of a group. Student teams working in classroom settings provide a useful research milieu for studying groups over time, because one can control data access and collection. This is harder to do in the field, but it is possible with subsequent surveys. Liao, Liu, and Loi (2010) looked at how team member self-efficacy develops over time as a result of the quality and differentiation of leader–member exchange (LMX) and team–member exchange (TMX) using three survey phases, each a month apart. Although self-efficacy was examined at the individual level, its development is a function of the emergent team properties of LMX and TMX. Wu, Tsui, and Kinicki (2010) used a similar approach to understand the development of collective efficacy as a result of leader behavior and group identification. They examined these as consecutively emerging properties.

Studying group dynamics over time is helped by simulation modeling. Fang et al. (2010) used simulation to test how the balance between exploration and exploitation could be maintained over time by keeping organizational groups somewhat isolated. Simulation requires precise specification of all the relationships among variables and their temporal characteristics. In creating their simulation, Fang et al. (2010) had to formalize the longitudinal relationships before they could model the behavior of the groups over time. This formalization provides explicit guidance to empirical researchers regarding the operationalization of such relationships. Fang et al. (2010) also draw specific conclusions about nonlinear performance loss that occurs as subgroup size increases, as well as the nonlinearity of that effect (loss is worse when moving from 7 to 14 members than when moving from 28 to 79 members). Such nonlinearity is testable.

Cause–effect relationships—still unidirectional. Longitudinal work can accommodate the memory and growth aspect of group dynamics, but one cannot understand recursive influence without examining feedback loops. Of the 60 variables in the longitudinal studies (21% of all variables), only 17 were part of feedback loops (6% of all variables).

An example of a between-construct feedback loop can be found in the work of Schulte, Cohen, and Klein (2010), who examined the co-evolution of network ties and perceptions of the team. Schulte et al. considered how actions taken by team members to connect with teammates for elemental interaction (such as advice or friendship) changes their perception of the team’s
level of psychological safety (i.e., the emergent property), which in turn affects subsequent decisions about whom to connect with. Alternately, Dierdorff, Bell, and Belohlav (2010) examined how TMX and performance co-evolve. But while Dierdorff et al. (2010) use the change in TMX to predict the change in team performance, they could have examined these in feedback loops because their data and method make such investigations possible. Unfortunately, they did not.

Within-construct feedback loops are rarely found in the literature, probably because it is counternormative to model how a construct can affect itself. Yet multilevel within-construct recursive relationships are often implied in research. Huber and Lewis’ (2010) paper on cross-understanding exemplifies in their description of how a TMS is simultaneously coming into being and affecting group member choices that strengthen the TMS (e.g., how to specialize their knowledge, where to seek information). Ashforth et al. (2010) talk explicitly about feedback within the construct of identity. Intrasubjective (individual) and intersubjective (group) identities are thought to be mutually reinforcing. Although these two kinds of identity are described as separate, their functional/structural relationship to each other resembles the multilevel feedback implied by emergence.

Only one empirical article implied a within-construct feedback loop. Penning and Wezel (2010) examined demographic diversity but partitioned this into a stock and flow relationship (Sterman, 2000), which essentially takes the same construct and separates the level that persists over time (the stock) from the rate of change to the stock (the flow). Penning and Wezel (2010) had the demographic overlap stock and the demographic overlap flow. Unfortunately, though these constructs imply a potential feedback relationship—the flow increases the stock, which may then change the rate of flow; this latter half of the feedback loop was not examined.

Evolutionary states—still mostly convergent. Ten years ago, Kozlowski & Klein (2000) wrote that research into convergent states, such as compositional ones, far outnumbered research on differentiation among team members, such as compilational ones. What is the situation today? Where individuals’ contribution to the collective construct was clear (e.g., not global performance ratings of teams, like a grade or the score on a management simulation game), 84% of emergent and 67% of cumulative constructs studied were convergence based (see Table 4). While we have not examined how this proportion has changed over time, we think that one should still agree that 77% of the total constructs being convergence based is too high, especially since of our three categories, two are differentiation based. It might be reasonable to expect that established team variables like collective effort (DeJong & Elfring, 2010), task conflict (Bendersky & Hayes, 2010), team identity (Jehn & Bezrukova, 2010), or cohesion (Menon & Philips, 2010) should be convergent for
continuity with older work. But even newer constructs like reliance on internal
team knowledge (Gebert, Boerner & Kearney 2010), cross-understanding
(Huber & Lewis, 2010), or team member formalism (i.e. ethics; see Pearsall
& Ellis, 2010) are still most likely to be convergent.

Differentiation in terms of variance compilation was more often in cumu-
lative constructs (32%, \( n = 29 \)) than emergent ones (7%, \( n = 8 \)). However,
most variance compilation constructs (\( n = 21 \)) are based in some form of
fixed diversity (e.g., race, gender, IQ, education level), while four others were
based in differences that will diminish over time (e.g., age diversity and
tenure diversity of various kinds; over time, all of these will become more
similar). Such constructs have a limited capacity for dynamic evolution, and
so studying them will improve our understanding of group dynamics only
marginally over convergent forms.

Regrettably, only 11 variables of the 286 represented the highest level of
team differentiation, patterned compilation. Of these 11, five were transactive
memory, four were faultlines or coalitions, one was team structure, and one
was role-identification behaviors. We have already used transactive memory
throughout the paper to exemplify patterned compilation, so let us instead
use team structure and role-identification behavior to provide new examples
of how patterned compilation can be studied. Bunderson and Boumgarden
(2010) examined the specialization, hierarchy, and formalization among
roles and role relations that emerged in a self-managed team—a kind of
general patterned compilation. It was assessed using a survey, much as TMS
can be (Lewis, 2003). An alternate means of examining patterned compilation
was used in Pearsall, Ellis, and Bell’s (2010) assessment of role-identification
behaviors. They had coders identify when teammates interacted in a way
that differentiated their knowledge and resources. Both are ways to capture
differentiation; both demonstrate that differentiation is important and func-
tional as an evolutionary endstate.

Context—still underutilized. Contexts are not dynamic, but they matter
for group evolution. Hackman’s advocacy of discovering the conditions
under which groups will more or less automatically flourish (Hackman,
2002; Hackman & Morris, 1975) highlights the role of context in group development. Alternately, Sterman’s (1989) work on groups managing production in the context of time delays in feedback about production demand demonstrates how this context is a robust predictor of the kinds of errors and interpersonal interactions that will arise. As he puts it, in this context, no matter who is in the group managing such a task, the nature of the mistakes, frustration, and misattribution of blame will be remarkably similar. Both Hackman’s and Sterman’s work imply that contextual phenomena affect the evolution and efficacy of groups.

Only 16% of the group constructs in our sample were contextual, and more than half of those were relegated to control variables (meaning that little theoretical attention was given to them). In addition, team evolution is rarely studied in relation to context. So while 20 of the 55 sample papers had the potential to study emergence in context (i.e., both contextual and emergent constructs in the models), only 12 of these used context substantively (i.e., not as a control variable), and only five of the studies were longitudinal. Skilton and Dooley’s (2010) theory about the danger of repeat collaboration on creativity is an example of how to use context to limit such undesirable evolution. They argue that teams where members continually worked together would develop an elaborate but frozen shared mental model. Essentially, they posit a self-limiting feedback loop where teams develop standard approaches to work, and these decrease the opportunities for creative abrasion and further reinforce the teams’ typical operating procedures. They suggest that management impose changes to teams’ standard operating procedures or a project charter that directs team activities to an unfamiliar part of their operational space. These contextual changes are thought to weaken the link between team member familiarity and the ability to use familiar approaches to the team’s task, disrupting the feedback loop.

Two empirical studies that did examine emergence in context (Gino, Argote, Miron-Spektor, & Todorova, 2010; Porter, Webb & Gogus, 2010) looked at changes in performance across time periods as a result of some mediator (transactive memory and collective goal orientation, respectively). In these studies, the mediators were measured once and performance was measured multiple times. This approach makes the lifespan of the group the focal dynamic (e.g., the usefulness of collective goal orientation across stages of a group’s development), but does not consider how the mediational processes might change over time. Examining how mediators change over time makes the focal dynamic a function of the internal workings of the group, not just the passage of time; but this emergence still needs to be understood in context.

To fully appreciate context, researchers must look beyond the often mundane contextual control variables. Tuggle, Schnatterly, and Johnson (2010) exemplified this in their examination of how board meeting
“formality”—the rigidity and level of structure of procedures governing interaction and time management imposed on board meetings—limits the evolution of entrepreneurial activity by top management teams. Control variables such as whether the CEO is also chair of the board of directors (CEO duality; see Skilton & Dooley, 2010), the space and time distance between group members (Farh, Lee, & Farh, 2010), or the top management team turnover rate (Messersmith, Guthrie, Ji, & Lee, 2010) are not mundane, but they could play a more substantive role informing group dynamics. For example, does CEO duality speed the disappearance of creative abrasion (Skilton & Dooley, 2010)? Does team separation slow the generation of task conflict (Farh et al., 2010)? Does the TMT turnover rate weaken the effects of pay dispersion on individual executive’s decisions to turnover (Messersmith et al., 2010)?

Specific Needs for the Integration of Knowledge About Group Dynamics

The last section showed that many of the conceptual advances supporting groups as dynamic have not diffused into the general practice of group research. While we do not expect that all group research must be dynamic, it will be hard to accumulate a body of knowledge on groups unless, going forward, dynamics are given consideration. In this section, we use particular phenomena to highlight specific concerns that arise from lack of clarity about group dynamics. This is analogous to the levels of analysis argument: not all research needs to be multilevel, but failing to be clear about level leads to subsequent misspecification of the focal relationships being studied (cf. Rousseau, 1985). This has the secondary effect of limiting the field’s ability to integrate knowledge about group phenomena.

Failing to account for the dynamic profile misspecifies the causes and effects of a phenomenon. To understand the dynamic nature of a phenomenon, researchers must synthesize knowledge from across multiple studies. When the same phenomenon is studied using different construct types but the implications of the differing dynamic profiles are not addressed, integration of the findings across studies to draw general conclusions about how the phenomenon evolves is difficult. It may also prevent deepening the understanding of a phenomenon.

For example, diversity in 2010 has been conceptualized as contextual (family ethnic background as the context in which the group acts; see Menon & Phillips, 2010), cumulative (the group has different proportions of stable member types; see Bendersky & Shah, 2010; Shaw et al., 2010), and emergent (changing perceptions of who is different and how much that matters; see Jehn & Bezrukova, 2010; Kane, 2010). If diversity is contextual, then it is fixed and unignorable (contextual constructs have a constant top-down influence). If diversity is cumulative, it may change with membership change, but will still be
considered unignorable (the properties that are being cumulated do not change over time). If diversity is emergent, it can change even without membership change. Reconciling these dynamic profiles are important if we are to link research on diversity together. If Shropshire (2010) posits that demographically diverse boards will be more open to innovative ideas, can that effect be extinguished through team identification (Jehn & Bezrukova, 2010)? If diversity of one’s group is a condition imposed by the university (as proposed by Menon & Phillips, 2010), is it treated the same way as if the group diversity simply was due to random assignment (e.g., Wu, Tsui, & Kinicki, 2010)?

Being more explicit about the dynamic profile of a construct and/or explicitly testing which conceptualizations make sense under what conditions helps to advance the understanding of the phenomenon. Continuing with diversity, some argue that the influence of ascribed differences (“subjective” diversity, an emergent construct) should not be measured without controlling for objective diversity (i.e., visible differences, a cumulative construct). But if diversity is a perception, then maybe this is backwards. Maybe one should only control for objective differences after one is sure people have noticed them in the first place. Looking deeper into the cumulative/emergent distinction might help to reconcile whether people are unable to set aside their biases toward identifiably different groups (see Knutson, Mah, Manly, & Grafman, 2007), if the bias might naturally weaken over time (Gonsalkorale, Sherman, & Klauer, 2009), or if the bias can change because people learn to correct for their immediate reactions (Wallaert, Ward, & Mann, 2010). Using the more general forms of diversity that Harrison and Klein (2007) advocate may be informative if their typology crossed with contextual, cumulative, and emergent profiles. For example, would groups react more negatively to disparity of rewards that are imposed by the organization (contextual), that are a function of the selection of the group members (cumulative), or that came about as a result of some group practice (emergent)? Dynamics are also important to understanding a phenomenon like diversity because constructs can be nested. For example, when objective diversity is stable but perceptions of diversity diminish (Harrison et al., 1998), has the influence of clearly visible demographic features (like race) disappeared, or merely been muted by the emergence of something else?

Diversity is only one example of how difficult it will be to accumulate knowledge about a phenomenon when research does not speak to the dynamic profile of the constructs used to study the phenomenon. Other examples exist. Interdependence between members can be imposed by the organization (contextual; e.g., the surgical team formed for a shift—see Chattopadhyay, Finn & Ashkanasy, 2010), can develop as the team works together (emergent; see Bunderson & Bougmarden, 2010), or can evolve a particular way because of the opposing action strategies imposed upon team operation (emergence in context; see Gebert, Boerner, & Kearney, 2010). Team
identity can be a contextual property assigned by an experimenter (see for example Kane, 2010), a cumulative one that depends on where members are located (see O'Leary & Mortensen, 2010), or an emergent one that is strengthened through interaction over time (Zietsma & Lawrence, 2010). We expect any team phenomenon that has been studied multiple times over the years to be characterized using different dynamic profiles across studies. Reanalyzing these existing findings in light of the differing dynamic profiles may actually provide a set of research questions about the dynamics of that phenomenon that will add to the knowledge base.

A final reason to pay attention to the dynamic profile of a construct is that some phenomena could be misconstrued as one type when they are better thought of as another. For example, faultlines are places where groups can fracture into subgroups based on the alignment of multiple demographic features (Lau & Murnighan, 2005). Since faultlines are often centered on demography, and demographics do not change based on individual interaction, one could characterize faultlines as a cumulative construct. However, this is limiting because it excludes any emergent individual attributes (political affiliation, beliefs, attitudes) that could be aligned to produce the same divisive effect. In addition, the faultlines construct also implies change without membership change: it considers situations in which groups are more likely to fracture into subgroups. This suggests changing perceptions lead to the salience of the subgroups. Without this dynamic, faultlines would not be places where the group could fracture; they would be divisions where the group has fractured. Thus, faultlines are correctly thought of as emergent (Bezrukova, Jehn, Zanutto, & Thatcher, 2009; Jehn & Bezrukova, 2010).

Failing to look beyond convergence misspecifies evolutionary possibilities. Kozlowski and Klein’s (2000) notion of compilation imply that (1) being in a group can cause differentiation among elements, and (2) this differentiation often happens over time. As we have seen, these processes are greatly understudied. We believe this is due to misspecification of what is seen as a legitimate group-level property. This is more a collective habit than an overt prescription by group researchers, and two factors contribute to its persistence. First is the substantial use of cumulative constructs, which limit how much one can examine differentiation. The second is the over-reliance on inter-rater agreement to validate group level constructs.

Cumulative constructs account for 33% of the total constructs studied. Cumulative constructs have the capacity for variance compilation, but are less amenable to patterned compilation. Cumulative constructs imply a kind of summary attribute of the group, so even when the elements are different (e.g., individuals are of different on attribute X), they are usually summed into a shared property (e.g., the group is diverse); this is how such cumulative constructs are used on attributes such as education level (Shaw et al., 2010) or
tenure (Bunderson & Boumgarden, 2010). Patterned compilation has the potential for what emerges at the group level to be more than the sum of the parts; the nature of cumulative constructs almost precludes this. In addition, cumulative constructs are most often (63%) based in unchanging features of the individuals (e.g., race, age, functional background, IQ), and so this precludes the potential for compilation to arise over time. Patterned compilation is much more amenable to differentiation.

The second pressure limiting the study of compilation is that subjective group constructs typically require validation (Chan, 1998; Chen et al., 2004), which is the act of providing evidence that construct $X$ is a function of the group milieu. Subjective constructs are typically validated by demonstrating convergence on the level of the construct within the group. The most commonly used metrics for this process, ICC and $r_{wg}$ scores, capture convergence by comparing how much variation on a variable is found within versus between groups (ICC), or how much agreement is found in comparison to a more general standard ($r_{wg}$). In our sample, where validation metrics were used, 84% of them used ICC and/or $r_{wg}$ scores.

The problem is that there are no methods currently available to validate that the group milieu caused members to become more different on some attribute. There are methods to characterize differentiation (e.g., variance on $X$), but these are measurements, not validations. So, for example, one can validate that a group increased the level of cohesion by examining whether there is less variance within than between groups. But there is no way to validate that a group increased conflict asymmetry because it is more asymmetric within groups than between. Researchers typically need to provide empirical validation of group-level emergent constructs (Chan, 1998). These do not exist for measures of differentiation.

These issues form a vicious cycle. Existing group constructs are mostly convergence based, which reinforces thinking of groups using the convergence lens, increasing the likelihood of a convergent construct being studied. If one were interested in differentiation, the tools for measurement and validation are mostly convergence based, making it harder to operationalize/validate the differentiation with established measures. Reviewers of this work would see these methods as atypical, decreasing the likelihood of publication. As a result, the work that is published will mostly be about convergence, which is what group researchers will read; and so the cycle starts again (Figure 3).

The focus on evolution toward convergence leads to a lopsided view of group dynamics. It is easy to see this lopsidedness—how composition is overrepresented and compilation is underrepresented. But focusing groups as convergence-inducing vehicles might have caused misspecification of constructs that we traditionally think of as compositional, like team mental models. In a recent review, Mohammed, Ferzandi, and Hamilton (2010) showed how TMMs demonstrate different patterns of findings based on whether the
measure of TMM elements used convergence or differentiation. Smith-Jentsch, Mathieu, and Kraiger (2005) used both correlation (a convergence measure) and variance (a differentiation measure), and found that TMMs had significant effects on group outcomes only when they were operationalized using the variance measure. Webber, Chen, Payne, Marsh, and Zaccaro (2000) found similar results. They argued that correlation and variance measures yielded different results because they capture qualitatively different phenomena. If that is so, then TMMs are underspecified with respect to the role played by differentiation. This may be one of many constructs where differentiation is underspecified.

Failing to account for path dependence can misspecify the strength of found effects. Path dependence implies that a construct’s influence at any point in time depends on the current state of the system. Path dependence has two critical implications for prediction and control of a phenomenon. First, what works at one point in time may not work at another. In a theory, this would be a boundary condition. Such boundary conditions are rarely part of theories, as time is typically understudied (Ancona et al., 2001). But without such boundary conditions, phenomena are erroneously thought to be more impactful and universal in their influence than they actually are. They might even be less persistent: Langfred (2009) presented work showing how early trust in a team, which might be assumed to persist and grow, actually undermines future trust.
A second implication of path dependence is that if the importance of a factor changes over time, failure to recognize this can lead to illusory contradictions across research. Consider the debate over whether task conflict is harmful, sparked by DeDreu and Weingart (2003). Jehn and colleagues (Jehn & Bendersky, 2003; Jehn & Mannix, 2001) have postulated that task conflict can be more or less effective, depending on when it occurs in a group’s life cycle. Others (Cronin & Bezrukova, 2010; Pruitt & Nowak, 2010) have postulated that conflict’s effects depend on how much conflict the group has already had. These temporal dependencies on the effect of conflict, and may explain why task conflict is often harmful. The contradiction is not between theory and research, but a result of not considering path dependence.

The Next Generation of Group Research

We reviewed the current state of group research and have found, like many of the reviews that have come before us (e.g., Kozlowski & Bell, 2003; Argote & McGrath, 2001; Sundstrom et al., 1990), that group dynamics are greatly understudied. Although conceptual tools that can be used to understand dynamic relationships in teams have existed for some time, they are mostly unused. We have also reviewed the problems that failing to study group dynamics portends. But since the conclusion about group dynamics being understudied seems persistent even in the face of methods to do so, we wish to offer some complementary suggestions for changing the approach to the study of groups. These might improve the odds that by the next review of group research, dynamics will be more thoroughly infused into the study of groups.

Changing the Focus of Attention

A simple step to advance the study of group dynamics is to think about whether change is possible and how it could occur with respect to the focal phenomena at the beginning of any research project. This is mostly a matter of devoting explicit attention to the following issues.

**Dynamic profiles.** Researchers should first consider what form their constructs should take: emergent, cumulative, or contextual. Does one have meaningful, substantive contextual constructs? Hackman (2002) and Sterman (1989) have both provided great models for how to think about context substantively—as has Johns (2006), albeit more broadly. If one has a cumulative construct, is one sacrificing needed dynamic capabilities, or does one have a way to test for punctuated change? If one has an emergent construct, can one track the evolution of emergence across levels (i.e., within-construct feedback)?
Once constructs are conceptualized, researchers should then consider how they fit together in a model. One can then make sure dynamics are represented: Are there sufficient emergent and contextual constructs? Are emergent constructs measured at multiple points in time? Is there the capacity to see whether context moderates emergence? Is there a way to see whether emergence causes turnover (punctuated change)? Are there feedback relationships? All of these are simply additional questions to consider when designing research.

**Evolutionary states.** Kozlowski and Klein’s (2000) concept of compilation helps us to understand the group as a milieu as a force that can specialize members’ perceptions or behaviors, rather than only homogenizing them. However, in their characterization of patterned compilation, they include emerging interdependence structures that are harmful to the group such as coalitions. A different kind of dysfunctional evolutionary process we could also include from the 2010 studies is disagreement over how much conflict the team has (Jehn et al., 2010). We think this kind of discord may be qualitatively different from the kind of adaptive specialization of compilation. More attention to this might push the compilation end of the continuum a bit further away from composition, but it represents an underexplored and fruitful aspect of groups.

In 2010, about eight convergent variables were studied for every compilational one. This means that even if the study of differentiated forms were to increase eightfold, the imbalance would continue to grow (albeit more slowly). We might correct the accumulated imbalance of convergent to differentiated constructs more quickly if researchers explicitly decided to shift away from studying composition in addition to studying more compilation.

**Absence of change.** Paying more attention to how constructs could change may be complemented by paying attention to times when something that should change does not (or changes more slowly/to a lesser degree than would be expected). For example, throughout much diversity research, faultlines, and subgroup research is the assumption that difference is socially problematic (Mannix & Neale, 2005)—i.e., when one is different others will notice and not like, listen to, etc. that person. Yet just because it is easy for people to see difference and react negatively to it does not mean that it is the only possible endstate that groups can evolve toward. Aside from being a rather negative view of human capabilities, this approach overlooks the considerable number of identifiable differences that group members may have but which do not result in a discordant state. Research could more systematically explore these cases, or perhaps look for situations where in-group prejudice should emerge but does not. This would tell us something new about diversity. A similar case could be made for many other phenomena as well (e.g., trust,
interdependence, conflict, cohesion, etc.). It is informative when they do not emerge and they should.

**Studying Groups Over Time**

Studying group dynamics requires examination of groups over time. This practice requires more than simply shifting attention, it requires solving some problems.

*Tractable longitudinal research.* To understand dynamics, we must do more longitudinal work, preferably with feedback loops in mind. Longitudinal work has many challenges, many of which are related to control of the data (e.g., keeping subjects, maintaining the integrity of a group over time). Researchers might try to think about using different research methods or combinations of methods to mitigate these challenges. For example, the dynamic decision-making task of identifying hostile aircraft is a laboratory task that is well studied and lends itself to control. The familiarity with this task should be leveraged to design more complicated longitudinal studies that address technically challenging questions, such as how feedback affects the emergence of particular constructs, or how different trajectories of emergence (i.e., rates of change rather than levels of a variable) may be predictive of other aspects of team functioning (see Porter et al., 2010). Alternately, one could use simulation in conjunction with field research to test predictions based on extrapolation from dynamic system models. One creates a dynamic simulation model from the array of tools that already exist and are widely used by system dynamics researchers (e.g., VenSim, PowerSim) or those who do agent-based modeling (see Frantz & Carley, 2009). Results are created with the intent of validating these in field settings.14

*Maximizing longitudinal data.* Studying a construct over time provides a new kind of variable that must be capitalized: the rate of change. The rate of change is the delta in some parameter between at least two points in time, and could be embodied in the slope of the line (e.g., Porter et al., 2010), a growth parameter (e.g., Schulte, Cohen, & Klein, 2010), or a stock-flow relationship (e.g., Pennings & Wezel, 2010) where the stock is the integral of the flow (or alternatively the flow is the derivative of the stock). Rates of change would be predictive of outcomes or even other mediators, and they represent another benefit to be extracted from longitudinal research.

**New Research Tools Needed for Studying Dynamics**

If we are to suggest that the next generation of group research needs to be longitudinal and require high conceptual and methodological sophistication,
we should expect to see mass exodus of all untenured researchers from this activity. It is unreasonable to expect the (new) group researcher to make a substantive contribution and create a new method and convince reviewers of their methodology in a single study. We therefore suggest that researchers create more tools to capture and validate the understudied aspects of group dynamics before attempting to study the dynamics of substantive group phenomena. This is a pragmatic suggestion. With respect to dynamics, the methodological gaps seem more obvious than the conceptual ones at the moment. Many authors have made substantial contributions exploring the nuances of multilevel phenomena. They, or others, could easily build new tools or methods from this foundation of knowledge. Once created, group researchers interested in studying particular phenomena may read about these new methods and see ways to apply those methods to their phenomena of interest. Thus it may be more productive to adopt a “if you build it, they will come” approach.

**Tools for validation.** As we have argued, it is possible that the group environment could cause members to differentiate for good or for ill, or that the group environment may affect the trajectory of change over time. When it comes to both characterizing and validating these kinds of evolution, methods are lagging (or lacking). There are not enough tools to characterize the variety of evolutionary paths a group could take if they are not converging, the ones that do exist do not have corresponding validation measures, and the ones that might are poorly understood.

Compilation is most often captured using heterogeneity measures, typically variance. Harrison and Klein’s (2007) recent paper on diversity types has made a significant contribution in this direction. This work has highlighted how, given different kinds of constructs, different models of the dispersion need to be used to capture difference structures in groups (e.g., “[Coefficient of variation] is not a universal diversity index”—Harrison & Klein, 2007: 31). They presented three conceptual frames: variety (number of different categories), separation (difference between members on a linear scale), and disparity (difference in distribution on an attribute). Yet even more models may be needed because unlike convergence where the measurement of agreement is a monotonic function, variation is not. The same level of variance may represent meaningfully different configurations of difference among elements (e.g., the same level of separation could represent moderate disagreement among all members, one strong outlier, or two distinct subgroups). For example, Weingart, Todorova, and Cronin (2010) examined incompatibility between group members’ mental models in a multifunctional group (i.e., representational gaps). They used variance to measure the degree to which representational gaps were unequally distributed among functions. In a three-function group, this measure could be connected to minority influence because high variance implies a minority influence structure (two
against one). In a four-function group, you could still have a minority influence structure (three against one); but you could also have factions (two against two).

It is critical to reinforce that while Harrison & Klein (2007) have provided three different ways to think about dispersion, their argument is about how difference should be modeled, not validated. In fact, we can think of no method that validates that the group milieu caused differentiation among elements. If it is important to validate that the group milieu made people more similar (as with direct consensus and referent shift models; see Chen et al., 2004), we find it hard to argue why it would not be important to validate that a group milieu made people differentiate, and this requires methods outside of ICCs or \( r_{wg} \). These methods must accommodate the range of situations on the compilation continuum (Kozlowski & Klein, 2000).

Lewis’ (2003) TMS scale is an example of how a survey can simultaneously assess convergence on some aspects and differentiation on another. But there must also be ways to validate disagreement when perceptions are not shared or implicit. Keller and Loewenstein (2010) presented a more general technique for assessing the balance of similarity and difference in a collective called the cultural consensus model. Such a technique was created by anthropologists (Romney, Batchelder, & Weller, 1987) to establish (1) whether there are commonly held beliefs within and across groups; (2) what those common beliefs are (i.e. one does not need to specify them \( a \ priori \)); and (3) how individuals in a group embody each cluster of beliefs. Applied to noncultural structures of beliefs or expectations in a group (e.g., task mental models), it represents a fairly organic way to assess both the convergence and differentiation of group members’ beliefs.

Any new models of differentiation that people create should come with good explanations for whether and how to validate them. Without these, we fear people will not know how to apply them to their own specific research. For example, Chan (1998) provided a category of process models that could conceivably capture evolution, but no way to validate them (since, he argued, they could come in an infinite number of forms). Process models are never referred to in the 2010 work, and were omitted from Chen et al.’s (2004) review of multilevel modeling techniques. We suspect that the underuse of Chan’s (1998) process models may in part be explained by a lack of guidance for how to use them. Direct consensus and reference shift models, both explained in detail by Chan (1998), are widely used. More guidance for researchers on how to use and validate models of evolution would help put them in circulation. When Chen et al. (2004) updated our knowledge about the use of multilevel models, they (unfortunately) used the most common aggregation model, direct consensus, as an example. What is needed is to do the same with the lesser-known models.
Tools for dealing with recursive relationships. Feedback between and within constructs makes the study of emergence substantially more complex than the typical linear model, but system dynamics (cf. Sterman, 2000) is a framework that may help in this capacity. System dynamics was created to help understand temporal dependence under conditions of feedback. System dynamics theory and agent-based simulation methods (Frantz & Carley, 2009; Smith & Conrey, 2008) can be used as a framework to help develop new ways to study evolution. Agent-based modeling allows the simulation of how systems evolve given various structures of autonomous agents interacting with each other and with a context. Smith and Conrey (2008) provide a useful guide to the agent-based modeling approach, and Fang et al.’s (2010) paper on the isolation of subgroups is an excellent example of this.

System dynamics and agent-based modeling are both formal (i.e., mathematical) approaches. For those working with empirical data, recent advances in structural equation modeling such as multilevel structural equation modeling can also help test hypotheses on the relationships between emergent states and processes on multiple levels of analysis over time (Asparouhov & Muthen, 2008; Preacher, Zyphur, & Zhang, 2010). Asparouhov and Muthen (2008) describe how to use multilevel structural equation modeling: a general statistical model that incorporates multilevel models, longitudinal models, and structural equation models into a flexible framework. Alternately, there are new techniques coming from the realm of network analysis that can help understand group evolution. Analysis of multilevel networks and network dynamics can also contribute to understanding how actors and their collective networks mutually constitute each other (see Brass, Galaskiewicz, Greve, & Tsai, 2004; Parkhe, Wasserman, & Ralston, 2006). Brass and colleagues review network literature and highlight ways to gain better understanding of network change and cross-level dynamics, i.e., how the agent influences the network and via versa over time (Brass et al., 2004). Network dynamics analysis helps understand the way individuals and networks influence each other and change over time (Kilduf, Tsai, & Hanke, 2006). There are also examples of theoretical work that adopts the system dynamics perspective. Though these may not be about groups per se, they demonstrate how to use systems concepts like path dependence (Sydow, Schreyögg & Koch, 2009), stock and flow systems (Rudolph, Morrison, & Caroll, 2009), and feedback (Todorova & Durisin, 2007).

Conclusion
Groups and teams are an increasingly important part of how organizations operate and how students are educated. Research on groups and teams has become quite popular (the most common keyword for the Academy of
Management Journal in 2007–2009 was group/team, at 24% of the articles; Morrison, 2010) and will probably continue to be. Research has progressed in many content areas such as team effectiveness (for review, see Mathieu et al., 2008), innovation (for review, see Hülsheger, Anderson, & Salgado, 2009), learning (Wilson, Goodman, & Cronin, 2007), cognition (DeChurch & Mesmer-Magnus, 2010), and diversity (Van Knippenberg, De Dreu, & Homan, 2004). But without simultaneous advancement in our basic understanding of groups as dynamic, it undermines the validity of the knowledge base we have, and undercuts the value of new research that continues to treat groups as they are not—static.

We have tried to give groups researchers some conceptual issues to think about that will enrich our understanding of teams as dynamic entities. We reviewed research on collective constructs (emergent, cumulative, and contextual) and the change processes that can be applied to these. We then clarified how the evolutionary process was dynamic by paying particular attention to the evolutionary paths that memory and recursion create. We discussed the types of structure that can arise as a group evolves. Having articulated these aspects of groups as entities, we took stock of the 2010 research on groups and teams.

What we saw in the research we sampled was little migration of the ideas we reviewed, and consequently little focus on group dynamics. We tried to highlight some of the work that was looking at group dynamics as a way to demonstrate how these admittedly complicated issues might be tackled. We also tried to further bolster concern for the lack of attention to group dynamics by showing some of the problems that are waiting to happen as the study of groups moves forward. We showed these in the context of particular phenomena, but then tried to show how the core issue generalized across group phenomena.

We concluded by offering some suggestions for how to change the practices of group researchers. The complaint that the study of groups is the study of “group statics” (McGrath, 1986) is a refrain that has been playing for a long time now, and has been noticed and noted many times before. We hope that our suggestions help the situation so that this is the last time that particular chorus will be sung.

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Endnotes

1. We will use the terms *group* and *team* interchangeably. In all cases, we mean a collective of individuals with at definable boundary who are interdependent and have a shared fate (Levine & Moreland, 1990).

2. It is worth noting that this review focuses on how the field thinks about groups and their properties, not the subjects of study with respect to groups. A good point of contrast is the Mathieu et al. (2008) paper, which uses a similar structure to this paper but was focused on content areas as opposed to conceptual/methodological ones. Mathieu et al. (2008) considered the important topics for group functioning identified 10 years earlier by Cohen and Bailey (1997), and reviewed the current literature to see how knowledge had advanced on these topics. We will do the same kind of taking stock, but we will focus on group construct properties (cf. Chan, 1998; Kozlowski & Klein, 2000) and evolution (cf., Ilgen et al., 2005; Marks et al., 2001) with respect to how groups themselves are conceptualized and studied.

3. It is possible to talk about contextual factors at higher levels (e.g., organizational, national), but these would not be group properties; they would influence group properties in cross-level models. Again, our focus is on group-level constructs and internal dynamics.

4. It is important to reinforce that we are focusing on group-level *constructs*, not models. That is, how a single variable $X$ relates to conditions at the individual level that are necessary for $X$ to exist (e.g., a shared mental model does not exist independently of the individual mental models that constitute it). This would be different from a cross-level model where an individual level construct $Y$ affects a different group-level construct $X$ (e.g., low openness to experience predicts less of a shared mental model).

5. Again, we are only talking about within-team effects. There are other multilevel feedback loops (global-contextual and perhaps local-contextual), but these are beyond the scope of this paper.

6. We use the summary sign to denote that the individual properties are located among the collective and not just in a single individual.

7. Contextual constructs can be in feedback loops with organizational or other factors external to the team (see Sundstrom [1990]); but these are beyond the scope of this paper.

8. We exclude “minimum/maximum compilation” because that is a function of a single individual in a group, not the collective. This is in conflict with our original definition of what constitutes a group-level construct (Chan, 1998; Rousseau, 1985).

9. These are noted with an asterisk in the reference section.

10. In studies like this, constructs did not change form across the studies (i.e., they were not contextual in one study and emergent in another).

11. In four papers, a variable was both IV and DV; we coded these as IVs.

12. Some group-level constructs are objective (e.g., the size of a team, the gender composition) and do not require validation.
13. The majority of the remaining validation was done with external raters, with the exception of a single use of awg (van Knippenberg, Kooij-de Bode, & van Ginkel, 2010).

14. This technique is an adaptation of Herbert Simon’s method of creating computational models of thinking and then validating such models with human experimental data.

15. Since diversity represents a state of divergence, conceivably these could be applied to any construct where the individuals who produce it do so on the basis of difference.

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* Denotes studies included in the sample of 2010 group research.


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