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Rethinking Virtuality and Its Impact on Teams

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Rethinking Virtuality and Its Impact on Teams

Mary K. Foster¹, Augustus Abbey¹, Michael A. Callow¹, Xingxing Zu¹, and Anthony D. Wilbon²

Abstract
We propose an extension of the Hollenbeck, Beersma, and Schouten team context model to include a fourth dimension: virtuality—the distance between team members. Based on an analysis of 29 unique approaches to conceptualizing virtuality and a critical comparison of these approaches with the Hollenbeck et al. framework, we recommend that virtuality be measured, along with skill differentiation, authority differentiation, and temporal stability when conducting team research. We conclude that the addition of this redefined construct, virtuality, is warranted based on the following: (a) its uniqueness versus the other dimensions, (b) its impact on team outcomes, and (c) the moderating or interaction effects between virtuality and the other contextual dimensions.

Keywords
virtuality, team, virtual teams, virtual groups, performance, interaction

Over the last 20 years, globalization and innovations in technology have taken the widespread organizational use of teams in a new direction—toward virtuality. According to the Society for Human Resource Management, 66%
of multinational organizations use virtual teams and 46% of all organizations use virtual teams (Minton-Eversole, 2012). Yet, the conditions that foster virtual team effectiveness remain elusive (Minton-Eversole, 2012; Ortiz de Guinea, Webster, & Staples, 2012; Webster & Staples, 2006). Lack of agreement about how to conceptualize important contextual aspects of teams, such as virtuality, has been a roadblock to progress in the field (Hollenbeck, Beersma, & Schouten, 2012). In this article, we propose an extension of the Hollenbeck et al. (2012) team context framework as a way to overcome this obstacle.

Hollenbeck et al. (2012) reviewed 42 different definitions of team types and identified three key contextual dimensions of teams: skill differentiation, authority differentiation, and temporal stability. This conceptual framework, which can be used to differentiate between teams, was created to stimulate a shift in thinking in the field and encourage a consensus on the critical contextual dimensions most useful for comparing and contrasting teams. They acknowledged that there might be more than three dimensions and even suggest that some conceptualization of virtuality might be a possible fourth dimension.

We argue that virtuality is an important contextual variable that should be taken into consideration in all teams and team research. We extend Hollenbeck et al.’s (2012) research by analyzing 29 unique approaches to conceptualizing virtuality, not included in their original analysis of team types, and comparing/contrasting these conceptualizations with the three dimensions they identified. We conclude that the addition of a redefined construct, virtuality, is warranted based on its uniqueness, its impact on team outcomes, and its interaction effects with other contextual dimensions.

We posit that virtuality is a significant contextual variable—a condition that can help us more fully understand and assess teams. “Context can have both subtle and powerful effects on research results” (Johns, 2006, pp. 386-387). Consideration of context can help (a) explain study-to-study variation; (b) describe situations in which phenomena or relationships apply; (c) reduce consideration of isolated, and thus potentially misleading, situational forces; and (d) facilitate aggregation and synthesis of information across studies (e.g., meta-analyses). Although there is broad agreement about the importance of context, there is less agreement about how to describe or characterize context (Cappelli & Sherer, 1991; Johns, 2001, 2006; Mowday & Sutton, 1993; Rousseau & Fried, 2001).

For example, in the field of team research most models of team effectiveness include contextual variables like team characteristics (e.g., team size, team diversity, teamwork skills) and organizational or environmental factors (e.g., reward and recognition systems, availability of training and support;
Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; Cohen & Bailey, 1997; Hackman, 1983, 1987; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Ilgen, 2006; Mathieu, Maynard, Rapp, & Gilson, 2008; McGrath, 1964; Rico, de la Hera, & Tabernero, 2011; Steiner, 1972). However, as Hollenbeck et al. (2012) note, there is no consensus on how to describe or classify teams.

The same disconnect is evident in the subfield or specialty of virtual team research. Most models of virtual team effectiveness include contextual variables, similar to those found in team effectiveness models (Furst, Blackburn, & Rosen, 1999; Martins, Gilson, & Maynard, 2004; Powell, Piccoli, & Ives, 2004; Webster & Staples, 2006). Yet, there are at least 29 unique approaches to conceptualizing or describing the virtuality of teams.

Within the field of team research and the subfield of virtual team research, there is agreement that context is important, but there is a lack of agreement about how to describe or define context. In addition, neither perspective (i.e., team research or virtual team research) has given sufficient consideration to the work of others in the field when developing frameworks or models for assessing contextual variables. This lack of synthesis has contributed to the lack of coherence and consensus in the field.

As Platt (1964) argues, the lack of consensus in a field over several decades may signal lack of development and/or discipline within the field. Lack of consensus also hinders the integration and aggregation of results across studies and the generation of cumulative knowledge. Thus, the lack of agreement about how to conceptualize important contextual aspects of teams is a roadblock to progress in the field.

To address this issue, we propose an extension of the Hollenbeck et al. (2012) framework to include a fourth dimension: virtuality—the distance between team members. We argue that this more comprehensive framework of four continuous dimensions should be taken into consideration whenever conducting team research. Taking a comprehensive approach to describing team context and consistently applying it to team research could accelerate theory development and encourage the integration of virtual team and team research instead of its bifurcation.

**Team Context**

Teams have been conceptualized as complex, adaptive, dynamic open systems embedded in organizations or social systems, which are also conceptualized as complex, adaptive, dynamic open systems (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004; Ilgen, 1999; Kozlowski, Gully, Nason, & Smith, 1999; Mathieu et al., 2008; McGrath, Arrow, & Berdahl, 2000). Complex adaptive systems theory emphasizes the dynamic nature of
teams, where independent, intelligent agents, whose behavior is affected by physical, psychological, and social conditions, respond to opportunities and constraints, learning and adapting as they go (Anderson, 1999; Rouse, 2000). Teams both influence and are influenced by their context (Kozlowski & Ilgen, 2006). This contingent character of teams is incorporated into most models of team effectiveness, with contextual factors (i.e., circumstances, contextual dynamics, organizational context, situational characteristics, cultural context, environmental factors, group design, task structure, and group composition) presumed to play an important role in shaping team outcomes via direct, mediating, and/or moderating effects (Kozlowski & Ilgen, 2006; Mathieu et al., 2008; McGrath et al., 2000; Pina, Martinez, & Martinez, 2008). In complex adaptive systems, small changes may have significant impacts on the team, and the team may be very different from the sum of its parts (Anderson, 1999). Thus, team context, situational opportunities and constraints that affect the occurrence and meaning of team behavior (adapted from Johns, 2006) play a critical role in understanding team phenomena. Ignoring or piecemeal consideration of contextual elements may lead to range restriction, study-to-study variability that is difficult to explain, lack of study comparability, inability to aggregate and synthesize findings across studies, and threats to validity (Cappelli & Sherer, 1991; Johns, 2001, 2006; Mowday & Sutton, 1993; Rousseau & Fried, 2001). Thus, there is consensus in the field that team context matters in theory, research, and practice. Yet, there is little consensus on how to define or assess team context.

Team Types and Taxonomies

For decades, researchers have been proposing taxonomies, typologies, and classification systems to describe team context (Cohen & Bailey, 1997; Devine, 2002; Devine, Clayton, Philips, Dunford, & Melner, 1999; Guzzo & Dickson, 1996; Hackman, 1990; McGrath, 1984; Pina et al., 2008; Sundstrom, DeMuse, & Futrell, 1990; Sundstrom, McIntyre, Halfhill, & Richards, 2000). The thought was that if team context could be classified by task or type, then it would be easier to understand team phenomena, generalize findings across studies, build theory, and inform practice. However, as Devine (2002) notes in his review and integration of team-related classification systems, none of the proposed systems have been widely adopted by organizational scholars and practitioners. Hollenbeck et al. (2012) reached much the same conclusion: There is “a confusing plethora of alternate team taxonomies and no consensus regarding how to classify teams” (p. 82).

Hollenbeck et al. (2012) contend that the plethora of taxonomies and team types is a barrier to progress in the field (i.e., it makes aggregation and
synthesis of findings and meta-analyses more difficult). They further argue that such categorizations often imply a dichotomy or perfect negative relationship between two types that does not hold up to scrutiny. Such categorizations may also limit the size and variability of effects making it more difficult to detect moderators and boundary conditions. Thus, they propose identifying a few critical dimensions for differentiating teams and then using those continuous dimensions to analyze and compare teams rather than categorizing them into dichotomous combinations.

Through their analysis of more than 42 different team types, they found three widely used underlying dimensions, which they propose as a framework for describing teams: skill differentiation, authority differentiation, and temporal stability. They define skill differentiation very broadly—essentially any social-informational differentiation that may result in people bringing a unique perspective to the team. This dimension captures an array of differences from differences in culture and gender to differences in experience and education. Authority differentiation is defined as differences in authority to make decisions from full leader control to complete self-management. Temporal stability refers to the stability of team membership and expectations about working together from stable, ongoing teams to short-term, ad hoc teams.

Hollenbeck et al. (2012) suggest that a dimensional scaling approach, if consistently applied to team research, would allow us to better describe the nature of teams studied, the boundary conditions associated with relationships between variables, and the mediating/moderating conditions. Furthermore, the use of continuous, normally distributed, differentiating dimensions, as opposed to dichotomous or nominal types, would increase statistical power for detecting team-related effects.

Hollenbeck et al. (2012) acknowledge that there might be more than three important contextual dimensions for teams. They even suggest that “degree of virtual presence” might be a fourth dimension (Hollenbeck et al., 2012, p. 101). However, their analysis did not include taxonomies or definitions related to virtual teams, even though they evaluated a number of single team type definitions (e.g., cross-functional teams, X-teams [Ancona, Bresman, & Kaeufer, 2002], extreme action teams, hierarchical decision-making teams, judge advisor systems, self-managing teams, and top management teams). The failure to incorporate virtuality perspectives as part of their team context analysis suggests that further investigation is warranted to ensure completeness.

**Rethinking Virtuality**

Examination of conceptualizations of virtuality in comparison with team perspectives on context is important to ensure completeness of analysis and...
integration within the field. To accomplish this, an electronic search of 69 EBSCO host databases (including Academic Search Complete, Academic Search Premier, Business Source Complete, PsychARTICLES, PsychINFO, and Social Sciences Full Text) was conducted using the search terms *virtuality dimensions* plus *virtual* or *distributed* and *groups* or *teams*. From this search and sources subsequently found through the reference sections of the originally identified articles, 117 articles and 7 books were reviewed to identify unique contributions to the literature regarding definitions of virtuality. For a contribution to be included in this analysis, it had to be the first mention of a specific idea regarding a dimension or dimensions of virtuality. So, articles that merely referenced an idea or ideas that had been introduced by others were not included. But articles that introduced new ideas or expanded or built on others’ ideas about virtuality were included, regardless of the type of study. A total of 27 references, from 1995 to 2012, with 29 unique conceptualizations of virtuality were identified and are summarized in Table 1, documenting the evolution of thinking about virtuality and comparing it with Hollenbeck et al.’s (2012) contextual dimensions for differentiating teams.

In our review of virtuality definitions and dimensions, most authors conceptualize virtuality as a multidimensional construct; only two assert that it is a single dimension. Fiol and O’Connor (2005) argue that virtuality is the extent of face-to-face contact among team members, whereas Saunders and Ahuja (2006) propose that virtuality is solely the extent of team member geographic distribution. Among those authors who assert virtuality is a multidimensional construct, the number of dimensions proposed varies from two to six, with most (11 of 25) identifying three dimensions; 5 of 25 authors identify four dimensions. An idea recently introduced by Dixon and Panteli (2010) and further elaborated by Watson-Manheim, Chudoba, and Crowston (2012) is that virtuality is dynamic (i.e., the dimensions of virtuality may change over time) depending upon perceived discontinuities and the continuities that develop in response to perceived discontinuities. The most frequently cited dimensions of virtuality are geographic or spatial distance (19 of 27), temporal or time differences (14 of 27), organizational differences, and cultural distance (10 of 27 for each). However, Schweitzer and Duxbury (2010) argue that geographic and temporal dispersion are the only criteria that differentiate virtual teams from proximate teams because traditional face-to-face teams can experience organizational and cultural differences.

Turning to the comparison of Hollenbeck et al.’s (2012) dimensions for describing teams and the dimensions proposed to describe virtuality, each model of virtuality was reviewed in detail looking not just at labels but also at definitions, examples, and measures. Then each model of virtuality was evaluated and compared with Hollenbeck et al.’s three-dimensional framework for
Table 1. Definitions and Dimensions of Virtuality Compared With Team Differentiating Dimensions (in Chronological Order).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Definition</th>
<th>Skill differentiation</th>
<th>Authority differentiation</th>
<th>Temporal stability</th>
<th>Degree of virtuality</th>
<th>Other</th>
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<tbody>
<tr>
<td>Definition of the continuous dimension:</td>
<td></td>
<td>Differences in experience, education, culture, gender, etc. (bring a unique perspective)</td>
<td>Differences in authority to make decisions from full leader control to complete self-management</td>
<td>Stability of membership and expectations of working together from stable ongoing to short-term ad hoc</td>
<td>Distance between members</td>
<td></td>
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<tr>
<td>Armstrong and Cole (1995, p. 183)</td>
<td>Distance is multidimensional: Geographic, time, organizational, and cultural distance are experienced by distributed or virtual teams</td>
<td>Cultural distance (national) Organizational distance (organizational, departmental, functional, levels, work culture differences)</td>
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<td>Geographic distance Time distance (i.e., time zones)</td>
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<tr>
<td>Lipnack and Stamps (2000, p. 61)</td>
<td>Boundary spanning. Typology of nine varieties of virtuality created by two dimensional matrix (3 × 3) of organization boundaries (same, cross-internal, cross-external) and space-time (same place, local, global)</td>
<td>Organizational boundaries</td>
<td></td>
<td></td>
<td>Space-time distribution</td>
<td></td>
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<tr>
<td>Fisher and Fisher (2001, pp. 44-51)</td>
<td>Typology of six types of virtual teams based on three continuous dimensions (2 × 2 × 2): Culture (same, different), space (same, different), and time (same, different)</td>
<td>Culture (same, different)</td>
<td></td>
<td></td>
<td>Space (same, different), Time (same, different)</td>
<td></td>
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<tr>
<td>Griffith and Neale (2001, pp. 385-386)</td>
<td>Two dimensions of virtualness: Percentage of work that the group does with its members distributed across time or space; level of technological support used by the group. Pure virtual teams = never meet face-to-face, regardless of technology use. Pure face-to-face teams do all of their work face-to-face and use no technology (pure face-to-face/traditional, hybrid, pure virtual)</td>
<td></td>
<td></td>
<td>Percentage of work that the group does with members distributed across time or space</td>
<td>Level of technological support used</td>
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</thead>
<tbody>
<tr>
<td>Bell and Kozlowski (2002, pp. 21-25)</td>
<td>Typology—Two characteristics that differentiate virtual teams from conventional teams: Spatial distance and technology-mediated communication</td>
<td>Boundary spanning (e.g., functional, organizational, cultural)</td>
<td>Life cycle (duration of team and stability of membership)</td>
<td>Temporal distribution (i.e., entrained in real time vs. distributed across time)</td>
<td>Spatial distance</td>
<td>Technology-mediated communication</td>
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<tr>
<td>Four continuous dimensions</td>
<td>Four continuous dimensions differentiate virtual teams (one end represents a prototypical virtual team and the other represents a traditional or virtual team): Temporal distribution (entrained in real time vs. distributed across time), boundary spanning (functional, organizational, cultural), life cycle (duration of team and stability of membership), member roles (multiple interchangeable roles to specific roles)</td>
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<tr>
<td>King and Frost (2002, p. 4)</td>
<td>Ambiguities associated with temporal, geographic, and social distance</td>
<td>Social distance</td>
<td></td>
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<tr>
<td>Kirkman, Rosen, Gibson, Tesluk, and McPherson (2002, p. 69)</td>
<td>Three dimensions: Proportion of time that team members work face-to-face; proportion of team members at any one location; proportion of time members devote to the team</td>
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<tr>
<td>Watson-Manheim, Chudoba, and Crowston (2002, p. 194)</td>
<td>Work that spans one or more discontinuities. Discontinuities are gaps or lack of coherence in aspects of work (temporal, cross-sectional). Examples: Physical location, temporal location, work group membership, organizational affiliation, relationship with an organization (e.g., permanent vs. self-employed or temporary worker), culture (functional, organizational regional, national)</td>
<td>Culture discontinuities (functional, organization, regional, national)</td>
<td>Discontinuities in relationship with an organization (organizational affiliation, permanent, self-employed, temporary, etc.)</td>
<td>Discontinuities in work group membership</td>
<td>Discontinuities in temporal or physical location</td>
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<td>Author, year</td>
<td>Definition</td>
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<tr>
<td>Espinosa, Cummings, Wilson, and Pearce (2003, p. 158)</td>
<td>Boundaries or discontinuities, edges or other dividing characteristics present in the work context of a team. Explored five types of boundaries: Geographic, functional, temporal, identity, and organizational</td>
<td>Functional boundaries</td>
<td></td>
<td></td>
<td>Geographic boundaries</td>
<td>Identity boundaries (competing demands of multi-team membership)</td>
</tr>
<tr>
<td>Griffith, Sawyer, and Neale (2003, pp. 267-268)</td>
<td>Three dimensions of virtualness (added one, physical distribution): Percentage of work that the team does with its members distributed across time or space, level of technological support used by the team, and distribution of the physical locations occupied by members. Propose three distinct categories of teams: Traditional, hybrid, and pure virtual</td>
<td></td>
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<td>Percentage of work that the group does with members distributed across time or space</td>
<td>Level of technological support used</td>
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<tr>
<td>Hinds and Bailey (2003, p. 616)</td>
<td>Two dimensions: Geographic dispersion and technology mediation (forced to rely on technologies to mediate communication and collaboration)</td>
<td>Geographic dispersion</td>
<td></td>
<td></td>
<td>Geographic dispersion</td>
<td>Technology mediation (forced to rely on technologies to mediate communication and collaboration)</td>
</tr>
<tr>
<td>Zigurs (2003, p. 340)</td>
<td>Four or more dimensions: Geographic, temporal, cultural, organizational dispersion</td>
<td>Cultural dispersion</td>
<td></td>
<td></td>
<td>Geographic dispersion</td>
<td></td>
</tr>
<tr>
<td>Martins, Gilson, and Maynard (2004, p. 808)</td>
<td>Three dimensions of virtuality or virtualness: Location/geographic dispersion; temporal (life cycle length, synchronicity of member interactions); relational (differences in affiliations—Teams, departments, organizations, cultural subgroups</td>
<td>Relational boundaries</td>
<td></td>
<td>Temporal (life cycle length—Short to long)</td>
<td>Location/geographic dispersion</td>
<td>Temporal (synchronicity of member interactions)</td>
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<tbody>
<tr>
<td>Chudoba, Wynn, Lu, and Watson-Manheim (2005, pp. 281-286)</td>
<td>Virtuality index: Theorized six discontinuities (factors contributing to a lack of cohesion between workers in a collective situation): Geography, time zone/temporal, culture, work practices, organization, and technology</td>
<td>Discontinuities of culture, organization, work practices, and technology</td>
<td>Discontinuities of geography and time</td>
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<td>Theorized six discontinuities</td>
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<tr>
<td>Found three factors</td>
<td>Empirically identified three discontinuities: Team distribution, workplace mobility, and variety of practices (see items included in each dimension for proper interpretation).</td>
<td>Variety of practices: Projects that have changing team members. Teams have different ways to track their work. People use different collaboration technologies.</td>
<td>Team distribution: Collaborate with people in different time zones. Work with people via Internet-based conferencing. Collaborate with people who have never met face-to-face.</td>
<td>Workplace mobility: Work at different sites. Interact with people outside the organization. Work with mobile devices. Work while traveling.</td>
<td>Extent of face-to-face contact among members. Other tendencies (i.e., technological support, dispersion), but not defining traits. “Virtual” refers to pure virtual and hybrid.</td>
<td></td>
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<tr>
<td>Fiol and O’Connor (2005, p. 20)</td>
<td>One dimension, not a continuum: Extent of face-to-face contact among members. Other tendencies (i.e., technological support, dispersion), but not defining traits. “Virtual” refers to pure virtual and hybrid.</td>
<td></td>
<td></td>
<td>Extent of face-to-face contact among members.</td>
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<td>Kirkman and Mathieu (2005, p. 702)</td>
<td>Three dimensions: Extent to which members use information and communication technology to coordinate and execute team processes, the informational value of tools/technology used, the synchronicity of member interaction</td>
<td></td>
<td></td>
<td></td>
<td>Extent to which members use information and communication technology to coordinate and execute team processes</td>
<td></td>
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<tr>
<td>Gibson and Gibbs (2006, p. 455)</td>
<td>Four dimensions: Geographic dispersion, electronic dependence, dynamic structure (membership and operating structure), and national diversity</td>
<td>National diversity</td>
<td></td>
<td></td>
<td>Dynamic structure (membership and operating structure)</td>
<td>Geographic dispersion</td>
</tr>
<tr>
<td>Saunders and Ahuja (2006, p. 663)</td>
<td>One dimension: Geographically distributed</td>
<td></td>
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<td></td>
<td>Geographic dispersion</td>
</tr>
<tr>
<td>Macduffie (2007, pp. 553-554)</td>
<td>Four dimensions: Recommends adaptation of Ghemawat’s CAGE framework—Cultural (national and organizational), administrative (administrative/organizational boundaries/discontinuities), geographic, and economic (i.e., employment status) distance</td>
<td>Cultural distance (national and organizational)</td>
<td>Administrative distance (administrative/organizational boundaries/discontinuities)</td>
<td>Economic distance (i.e., employment status or power differences)</td>
<td></td>
<td>Geographic dispersion, Geographic distance</td>
</tr>
<tr>
<td>O’Leary and Cummings (2007, p. 434)</td>
<td>Three dimensions: Spatial (average spatial distance among team members), temporal (extent to which members have overlapping work hours), and configurational (number of sites at which members are located, their isolation from other members, imbalance (the balance between subgroups across sites). Virtuality distance index = physical + operational + affinity distance</td>
<td></td>
<td></td>
<td></td>
<td>Spatial dispersion, Temporal dispersion, Configurational dispersion (number of sites, isolates, imbalance)</td>
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<tr>
<td>Lojeski and Reilly (2008, pp. 25-49)</td>
<td>Three dimensions of virtual distance: Affinity distance (cultural, social, relationship, interdependence), physical distance (geographic, temporal, organizational), and operational distance (communications, multitasking, readiness, distribution asymmetry)</td>
<td>Affinity distance (cultural, social, relationship, interdependence)</td>
<td>Operational distance (communication, multitasking, readiness, distribution asymmetry)</td>
<td>Physical distance (geographic, temporal, organizational)</td>
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<tr>
<td>Schmidt, Temple, McCready, Newman, and Kindler (2008, pp. 100-107)</td>
<td>Six dimensions: Quantitative degree of virtuality (to what extent is face-to-face interaction digitally represented)—synchronicity, digitality, frequency; Qualitative degree of virtuality (to what extent are formal, task-related and informal, person-related contents exchanged)—informality/person-relation, formality/task relation, frequency</td>
<td>To what extent is face-to-face interaction digitally represented: Synchronicity Digitality Frequency To what extent are formal, task-related and informal, person-related contents exchanged: Informality/person-relations Formality/task relation Frequency Perceived discontinuities</td>
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<tr>
<td>Dixon and Panteli (2010, pp. 1179-1180)</td>
<td>Discontinuity = perception of problems of communicating and interacting across a boundary, discontinuities are perceived and may be dynamic (e.g., differences in physical location, time zones, language, culture, professional norms/practices, organizational culture/practices)</td>
<td></td>
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<td>Perceived discontinuities</td>
<td></td>
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<tr>
<td>Schweitzer and Duxbury (2010, pp. 274, 278, 281-284)</td>
<td>Criteria of virtuality</td>
<td>Two criteria of virtuality: Time and distance</td>
<td></td>
<td>Geographic dispersion Temporal dispersion/ asynchronicity</td>
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### Table 1. (continued)

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<tr>
<td><strong>Dimensions of degree of virtuality</strong></td>
<td>Four dimensions: The extent that team members do not work face-to-face, the distance between members, their configuration or collocation patterns, and the extent that they work asynchronously</td>
<td></td>
<td></td>
<td>The distance between team members</td>
<td></td>
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</tr>
<tr>
<td><strong>Measures of virtuality</strong></td>
<td>Three measures of virtuality: Team time worked virtually—proportion of time spent working apart (i.e., not face-to-face); member virtuality—proportion of team members at different locations; distance virtuality—the distance between team members or the amount of effort or travel time necessary to meet as a team</td>
<td></td>
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<tr>
<td>Watson-Manheim, Chudoba, and Crowston (2012, pp. 29-30, 32-37)</td>
<td>Dynamic boundaries, which may result in perceived, dynamic discontinuities and continuities</td>
<td></td>
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</tbody>
</table>

*Time spent working apart may be independent of spatial/temporal dispersion.*

*Study conducted at the individual level.*

*Conceptualized at the organization/individual levels.*
describing teams to determine the degree of overlap and/or if any additional
dimensions could be identified. See Table 1 for a comparison of virtuality
dimensions with Hollenbeck et al.’s team differentiating dimensions.

More than half of the conceptualizations of virtuality incorporate a dimen-
sion that is consistent with the skill differentiation dimension in Hollenbeck
et al.’s framework (15 of 29). Differences in national culture, organizations,
departments, functions, levels, work culture/practices or operational prac-
tices, and technology were cited as conditions that create dissimilarities, dis-
tance, boundaries, discontinuities, ambiguities, and dispersion within teams.
Cultural and organizational differences were most frequently invoked (10 of
15 and 9 of 15, respectively); see, for example, Armstrong and Cole (1995),
research teams proposed higher level conceptualizations: social distance
(King & Frost, 2002), relational boundaries (Martins et al., 2004), and affinity
distance (Lojeski & Reilly, 2008), all referring to socially constructed
differences that create different ways of approaching work. The idea, first
introduced by Chudoba, Wynn, Lu, and Watson-Manhein (2005) related to
virtual teams, that differences in work practices can create discontinuities for
teams, also fits within the skill differentiation dimension because it repre-
sents differences in expectations about how work gets done that may result in
unique perspectives. The differences in work practices may also overlap or be
confounded with differences in national, organizational, and functional cul-
tures. For example, engineers at Intel may get their product specification
information from a particular source whereas marketers at the same firm may
rely on a different source. It may be difficult to determine whether these dif-
fferences are cultural, functional, or normative, regardless, they represent real
differences in perspectives about work.

Only two of the conceptualizations of virtuality invoke an authority dif-
ferentiation dimension (Macduffie, 2007; Watson-Manhein et al., 2002).
Both argue that differences in employment status or the type of relationship a
worker has with the employer (i.e., permanent, temporary, self-employed,
etc.) can affect status and/or power relationships. Conceptually, this fits with
the idea that authority is differentiated within a team.

Some conceptualizations of virtuality include a temporal stability dimen-
sion (5 of 29). Prior to 2007, some researchers posited that virtuality implied
that a team was temporary (Jarvenpaa & Leidner, 1999), had a short life cycle
(Martins et al., 2004), and/or had dynamic or changing team membership
(Bell & Kozlowski, 2002; Gibson & Gibbs, 2006; Watson-Manhein et al.,
2002). More recent researchers have concluded that temporal stability is a
dimension, which may affect any team and is not a differentiating character-
istic of virtual teams (e.g., Schweitzer & Duxbury, 2010).
Almost all (24 of 29) conceptualizations of virtuality include a distance dimension. For examples, see Lipnack and Stamps (2000), Fisher and Fisher (2001), or Schweitzer and Duxbury (2010). There is no equivalent dimension in the Hollenbeck et al. (2012) model for describing teams.

Slightly more than half of the virtuality models (16 of 29) included a dimension or characteristic that at first glance appears not to be captured by the four contextual dimensions discussed so far. Three additional themes or characteristics of teams were found that warrant additional discussion: how technology is used, face-to-face interactions, and extent of multi-team membership. In the following sections, we examine each of these characteristics to determine whether or not they represent an important, new contextual condition of teams.

**Use of Technology**

How technology is used included ideas such as electronically communicating or technology-mediated communication (Hinds & Bailey, 2003; Jarvenpaa & Leidner, 1999), the level of technological support used (Griffith & Neale, 2001; Griffith, Sawyer, & Neale, 2003), available technological support (Suh, Shin, Ahuja, & Kim, 2011), the extent of member use of information and communication technologies to do teamwork (Kirkman & Mathieu, 2005), electronic dependence (Gibson & Gibbs, 2006), and the extent of face-to-face interaction that is digitally represented (Schmidt, Temple, McCready, Newman, & Kinzler, 2008). But, are these ideas distinguishing characteristics of virtual teams or even all teams? These ideas are based on an implicit assumption: that the more geographically distributed people are, the more likely they are to use information and communication technologies to communicate and that the less distributed people are, the less likely they are to use information and communication technology to communicate. As Kirkman and Mathieu (2005) and others (Griffith et al., 2003; Hinds & Bailey, 2003; Webster & Staples, 2006) point out, this assumption is flawed. People/teams that are co-located may use technology-mediated communication just as much as distributed people/teams (Mortensen & Hinds, 2001), and distributed people/teams may use face-to-face communication just as much as co-located teams (Hinds & Mortensen, 2005).

Furthermore, work by Allen (2007) indicates that communication media choice is independent of the distance separating communicators. In addition, communication media use tends to correlate; for example, the people you communicate with the most face-to-face are also the people you are most likely to communicate with via phone and email (Allen & Henn, 2007). In fact, there is some evidence that using multiple media modes
(e.g., face-to-face, telephone, email, etc.) improves team communication regardless of geographic dispersion (Mesmer-Magnus, DeChurch, Jimenez-Rodriguez, Wildman, & Shuffler, 2011). Furthermore, theory and research suggest that the efficiency and effectiveness of communication are maximized by using multiple communication media modes in successive, iterative patterns (Allen, 2007; Mesmer-Magnus et al., 2011; Stephens, 2007).

This evidence suggests that the use of information and communication technology is not unique to distributed people/teams and thus should not be conceptualized as part of virtuality. As information and communication technologies become ubiquitous (Madden & Jones, 2008; The World Bank, 2013), technology-mediated communication will become characteristic of every team, regardless of the distance separating them (see Figure 1). Furthermore, differences in norms or work practices related to the use of media are captured in the skill or social-informational differentiation dimension identified by Hollenbeck et al. (2012). Thus, how technology is used is not warranted as an additional contextual variable in the framework, because it is independent of virtuality and incorporated in the skill differentiation dimension.
**Face-to-Face Interactions**

Face-to-face communications and synchronicity of interactions are two other ideas proposed as dimensions of virtuality. These ideas are based on the assumption that if team members are spatially or temporally dispersed, it is more difficult to meet face-to-face or at the same time. Thus, researchers advocate determining the degree of virtuality by assessing the percentage of time that members work face-to-face (Kirkman, Rosen, Gibson, Tesluk, & McPherson, 2002), the extent of face-to-face contact among team members (Fiol & O’Connor, 2005), the extent that members do not work face-to-face (Schweitzer & Duxbury, 2010), the extent that team members work asynchronously (Schweitzer & Duxbury, 2010), and/or the synchronicity of team member interactions (Kirkman & Mathieu, 2005). Because team members can and do make media use choices independently of the distance between team members (Allen, 2007), the extent of real time and face-to-face communication is not a reliable surrogate for or indicator of spatial/temporal distribution. Distributed teams and proximal teams may use face-to-face meetings to the same extent (Hinds & Mortensen, 2005); therefore both the extent of face-to-face and the extent of synchronous communication are not distinguishing characteristics of virtuality. Further differences in media choices and usage are captured under the Hollenbeck et al. (2012) dimension of skill differentiation. Researchers interested in examining the distance between team members and media choices/usage should assess both contextual factors rather than make assumptions about the relationships.

**Multi-Team Membership**

The extent of multi-team membership was also proposed as a possible dimension of virtuality. The competing demands of multi-team membership might impact identity boundaries (Espinosa, Cummings, Wilson, & Pearce, 2003) or the percent of time members work on a team might affect their availability and commitment to work on other teams (Kirkman et al., 2002). Multi-team membership is an important phenomenon and possibly a distinguishing feature of teams, perhaps it is captured in the temporal stability dimension identified by Hollenbeck et al. (2012). One could envision team member differences in commitments to other teams resulting in the ebbing and flowing of member availability and commitment to a team. However, members of both spatially/temporally dispersed teams and proximal teams may experience multi-team membership and the stresses and advantages of such membership. Therefore, multi-team membership is not a distinguishing feature of virtuality and could be better accounted for as a component of temporal stability.
To summarize, the comparison of 29 proposed virtuality models with the Hollenbeck et al. (2012) model for describing teams shows that distance is the one, most frequently proposed, virtuality dimension not encompassed within the Hollenbeck et al. (2012) model. Other ideas about possible dimensions related to virtuality were either included in the Hollenbeck et al. (2012) model or not theoretically or empirically justified as an additional dimension.

Based on the above analysis, we propose the addition of a fourth dimension to the Hollenbeck et al. (2012) team description model: virtuality—the distance between team members at work. This differentiating characteristic of teams is not captured in the current model; it is the dimension most universally associated with virtuality in the review of virtuality models; and it is consistent with the conceptualization of virtuality as a continuous dimension. Furthermore, incorporation of this dimension ensures that an important missing perspective has been taken into consideration, and this encourages the integration of virtual team and team research instead of its bifurcation.

A small distance between team members would constitute low virtuality; a large distance between team members would constitute high virtuality. A team with all team members in the same physical space at work would have very little distance between them; thus, they would have low virtuality. A team with all team members in different physical places at work, perhaps spanning continents and time zones, would have very big distances between them, and thus have high virtuality. Note that distance refers to the actual physical distance between team members when working—this distance may be measured in distance (e.g., feet or miles) or travel time (e.g., minutes, hours, or days). A team with some combination of team members in the same physical space and team members at different physical locations would have moderate virtuality. Care must be taken to ensure that people assigned to a specific organizational unit but who are not physically present at the location of that unit (i.e., shift workers, frequent travelers, field-based workers) are not assumed to be in the same physical space as co-workers when assessing degree of virtuality.

The extreme conditions of low and high virtuality seem less likely to exist in organizations today. Think about how difficult it is to get everyone on a team into a room, on the same day, at the same time—a low virtuality scenario—even if they all live in the same city and work in the same general location (i.e., a building or campus). Consider the odds that everyone on a team would be in a different location or continent—a high virtuality scenario. However, moderate virtuality scenarios seem very likely—teams having one or more members in different physical places (this includes shift workers, travelers, field workers, etc., who are at home or out of the office while others are at work). Moderate levels of virtuality, may be more common, yet more complex and difficult to understand, simply because of the number of possible distance configurations.
O’Leary and Cummings (2007) suggest that distance or dispersion among workers includes three key concepts: the physical or geographic distance between team members, the configuration of team member locations across or within space (i.e., the number of sites, the number of isolates, imbalance across sites), and differences in work hours of team members (associated with differences in time zones or shifts). We argue that virtuality is the physical or geographic distance between team members when at work, which may be measured in units of distance or time. This conceptualization of virtuality captures the notion that people may have different work hours. If you work the night shift and your colleague works the day shift, you will be separated by physical distance when working (e.g., the distance between the workplace and your home). Likewise, if you work in different time zones you will be separated by physical distance. Thus, a separate dimension assessing differences in work hours may not be needed.

Furthermore, we argue that the configuration of team member locations is captured in skill differentiation via diversity in social-informational conditions. The number of sites, the number of members per site, and the number of isolates may be ways of explaining differences in social networks/alliances and access to informational resources. Therefore, only virtuality, defined as the physical distance between team members at work, is warranted as an addition to the Hollenbeck et al. (2012) framework (see Figure 2).

The Implications of Virtuality

As a distinctive contextual factor of teams, virtuality could influence team processes, emergent states, outcomes, and even other contextual factors. Effects could range from nothing to complex direct and indirect interactions. Associations might be positive or negative. There might be direct, moderating, or mediating conditions for relationships between virtuality and other team constructs. Or virtuality might be a direct, moderating, or mediating condition for the relationships between other team constructs. Theory and research will help us understand the complex realities of virtual teams, particularly those with moderate virtuality and the vast number of possible distance configurations associated with moderate virtuality. First, we will explore what current theory and research tell us about the potential impact of virtuality on teams. Then, we will examine some possibilities for better understanding virtuality using a complex adaptive systems perspective.

Theory

Social distance (Brewer, 1968; Jones, 2004; Moreland & Zajonc, 1982; Perloff, 1993; Rokeach, 1960), psychological distance (Liberman, Trope, &
Figure 2. Extended dimensional scaling framework for describing teams.  

Stephan, 2007), social identity (Tajfel, 1978, 1981; Tajfel, Billig, Bundy, & Flament, 1971; Tajfel & Turner, 1979), and self-categorization (Turner, 1982; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) theories in addition to Allen’s law of propinquity (Krackhardt, 1994), all suggest that the lack of proximity or distance between team members may result in negative effects
on team processes, emergent states, and subsequently team outcomes. Per these theories, virtuality may result in lack of attraction/liking, in-group favoritism/bias, and attribution biases. Virtuality may result in a lack of shared identity and the associated losses of cooperation, mutual influence, and commitment to norms. Virtuality may also result in a lower probability of communication. Thus, a number of theories suggest that virtuality is likely to have direct, negative effects on team processes and emergent states and indirect negative effects on team outcomes.

For example, Allen’s law of propinquity states that the greater the physical proximity of people, the higher the probability they will like each other (Krackhardt, 1994). Or, the farther the team members are from each other during work (high virtuality), the less likely they are to like each other. Thus, high virtuality may have a negative impact on liking, a component of team cohesion (Castaño, Watts, & Tekleab, 2013), which in turn may have a negative impact on team effectiveness. Thus, theory suggests that virtuality may have a direct negative effect on cohesion and that virtuality may moderate the cohesion–performance relationship, or cohesion may partially or fully mediate the virtuality–effectiveness relationship.

Looking at another example, self-categorization theory posits that if team members do not see themselves as having a shared identity, they are not likely to see themselves as a group and are not likely to realize the benefits of conformity to norms, cooperation, and trust (Hogg & Terry, 2000; Turner, 1982; Turner et al., 1987). Teams that have high virtuality may have a hard time seeing each other as members of the same in-group and thus would not be expected to experience the advantages associated with a shared social identity, this in turn may affect team performance, satisfaction, and viability. Thus, theory suggests that virtuality may have a direct negative impact on shared team identity, and virtuality may moderate the shared team identity–performance relationship, or shared team identity may partially or fully mediate the virtuality–performance relationship.

To summarize, from a theoretical perspective, virtuality is expected to have negative direct and indirect (mediated and moderating) effects on team processes, emergent states, and outcomes. And other contextual factors, processes, or emergent state may mediate or moderate the relationship between virtuality and other team constructs.

**Research Summaries**

Ortiz de Guinea, Webster, and Staples’s (2005) meta-analysis of 50 virtual team studies found a significant negative association between virtuality and cohesion and virtuality and communication, consistent with theory. In
addition, they found a significant positive association between virtuality and conflict, again consistent with theory. However, they also found virtuality to be significantly positively associated with team effectiveness (i.e., quality, productivity, and satisfaction). Their moderator analyses (i.e., individual vs. group level of analysis and student vs. employee teams) indicated that these findings are not generalizable. Thus, this research indicates that in some circumstances, virtuality has a negative impact on team processes and emergent states, but that under some conditions, other team contextual factors, processes, or emergent states offset these negative effects, and teams achieve positive outcomes. These meta-analytic findings suggest that there are other important moderating or mediating conditions, which affect the virtuality–effectiveness relationship, even changing its direction, that have yet to be identified or understood.

In Webster and Staples’s (2006) extensive review of empirical studies of geographically distributed teams (176 unique datasets), they found virtuality is most often captured as a dichotomous variable, and important moderating and contextual variables are often not assessed or confounded. Only 14 of the 176 studies actually measured virtuality or the distance among team members. Most studies compared co-located with distributed teams and suffered in terms of external validity. They posit that many of the relationships in their inputs-processes-outputs model of team effectiveness will be moderated by the virtuality of a team. For example, seven of their nine propositions posit that virtuality will positively moderate or strengthen the relationship between a team construct and team processes and outcomes (i.e., virtuality positively moderates or strengthens the relationships between team processes and outcomes and observed diversity, team duration, type of task, communication media, training, leader modeling, and transformational leadership). They also posit that virtuality moderates the openness to new experience–team performance relationship. Thus, they argue that virtuality interacts with many other contextual variables to affect team processes and outcomes.

A recent meta-analysis (Ortiz de Guinea et al., 2012) found that virtuality is positively related to task conflict and negatively related to communication frequency, knowledge sharing, performance, and satisfaction. However, only 16 of the 80 studies included in this meta-analysis actually used a continuous variable to measure virtuality. When just these studies were analyzed, the researchers found that virtuality was negatively related to task conflict, positively related to knowledge sharing and member satisfaction, and had no relationship with performance. The researchers concluded that the present body of virtuality research cannot be used to draw generalizable conclusions about the relationship between virtuality and its impact on team functioning or outcomes, because virtuality is most often captured as a dichotomous variable.
and important moderating, contextual variables are often not assessed. They recommend the use of a finer grained, multidimensional approach to measuring virtuality (and by implication other important team context dimensions). Adoption and widespread use of the revised multidimensional scaling framework for describing teams and their context, as recommended above, would address the issues they identified.

**Complex Interactions**

Some studies indicate that virtuality has a negative effect on team processes, emergent states, and outcomes. See, for example, the meta-analyses and review discussed above and Cramton and Webber (2005) and Siebdrat, Hoegl, and Ernst (2008). Yet, like the two recent meta-analyses, Siebdrat et al. found that the virtuality–performance link could be positive under certain team conditions. Perhaps, contextual factors such as shared work practices (skill differentiation), a strong team leader (authority differentiation), or long-term stable working relationships (temporal stability) moderate or mediate the virtuality–performance relationship.

Hinds and Mortensen (2005) find that more virtual teams were more likely to experience task and interpersonal conflict. They found that spontaneous communication indirectly and directly moderated the virtuality–conflict relationship. Furthermore, shared identity moderated the virtuality–interpersonal conflict relationship, and shared context moderated the virtuality–task conflict relationship. This example illustrates how various contextual dimensions may interact to affect team outcomes. Here a team process, spontaneous communication, and contextual factors, shared identity and shared contexts—which may be reasonable assessments of the skill differentiation contextual dimension—interact to affect the virtuality–conflict relationship.

Gibson and Gibbs (2006) find that geographic dispersion is negatively related to innovation and that a psychologically safe communication environment reduced those negative effects. Thus, their work supports the idea that virtuality has a direct negative relationship on a team outcome—innovation—and that the virtuality–innovation relationship is moderated by a team environment that is supportive of open and honest communication. As Edmondson (1999) notes, differences in team psychological safety can be explained by differences in support (skill differentiation) and team leader coaching (authority differentiation). Thus, understanding contextual factors such as skill differentiation and authority differentiation are crucial if we want to understand virtuality and its impact on teams.

To summarize, theory and empirical evidence suggest that virtuality is an important contextual factor that may have a negative impact on team processes,
emergent states, and outcomes. Skill differentiation, authority differentiation, and temporal stability may moderate or reverse the direction of the effects of virtuality on team outcomes (Gibson & Gibbs, 2006; Hinds & Mortensen, 2005; Siebdrat et al., 2008). Furthermore, team processes and emergent states (e.g., communication sharing practices, team psychological safety), alone or in conjunction with contextual factors, may moderate or mediate the effects of virtuality on team outcomes (e.g., Engel, Woolley, Jing, Chabris, & Malone, 2014; Gibson & Gibbs, 2006). We speculate that virtuality may moderate or reverse the direction of effects for authority differentiation; much like technology-mediated communication has been found to do so (Bollen & Euwema, 2013; Walther, Anderson, & Park, 1994; Weisband, Schneider, & Connoly, 1995). Virtuality may also moderate or reverse the direction of effects for skill differentiation as suggested by Staples and Zhao (2006). Or virtuality may exacerbate the negative effects of skill differentiation, authority differentiation, and temporal instability as suggested by many (Carmel, 1999; Fisher & Fisher, 2001; Gibson & Cohen, 2003; Hinds & Kiesler, 2002; Lipnack & Stamps, 2000; Nemiro, Beyerlein, Bradley, & Beyerlein, 2008). It is unlikely that we will understand the complex relationships between the four types of contextual conditions and their impact on and interaction with team processes, emergent states, and outcomes, unless these conditions are explored consistently when conducting team research.

Conclusions and Recommendations

Globalization and technology innovations have driven rising interest in virtuality and virtual teams (Cascio, 2000; The Economist Intelligence Unit [EIU], 2009; Fisher & Fisher, 2001; Macduffie, 2007; Townsend, DeMarie, & Hendrickson, 1998). The field of virtual team research developed in response to this interest, often led by practitioners (e.g., Fisher & Fisher, 2001; Lipnack & Stamps, 2000). The field coalesced around a definition of virtuality that assumed both geographic distance and technology-mediated communication (Gibson & Cohen, 2003; Lipnack & Stamps, 2000; Townsend et al., 1998). Substantial effort has been put into defining or elaborating on the construct of virtuality (e.g., the 29 unique conceptualizations reviewed here). Most of these models or definitions appear to have been developed without reference to, or much consideration of, prior work regarding team typologies and contexts. Even recent work on an integrated approach to describing teams (e.g., Hollenbeck et al., 2012) has been developed without much consideration of the virtual team literature. The result has been an unproductive divide within the field.

Now the basic assumption that geographic distance and technology-mediated communication are always coupled and that both are essential to the
definition of virtuality is being challenged (see arguments in “Rethinking Virtuality” section and Griffith et al., 2003; Hinds & Bailey, 2003; Kirkman & Mathieu, 2005; Schweitzer & Duxbury, 2010; Webster & Staples, 2006). Furthermore, as technology-mediated communication becomes ubiquitous, some argue all teams communicate electronically and that this is not a differentiating characteristic of virtual teams (Hinds & Mortensen, 2005; Mortensen & Hinds, 2001; Schweitzer & Duxbury, 2010; Webster & Staples, 2006).

There is substantial theoretical and empirical evidence that distance between team members has negative impacts on team processes, emergent states, and outcomes (see discussion in “Rethinking Virtuality” section and Ortiz de Guinea et al., 2012). However, we cannot yet generalize this finding to all types of teams in all conditions, primarily because to date, most virtual team research has not assessed virtuality as a continuous dimension or assessed other relevant contextual variables, and most team research has not assessed degree of virtuality.

We recommend that virtuality be redefined as simply the distance between team members at work and that this attribute, virtuality, be measured as a continuous variable along with skill differentiation, authority differentiation, and temporal stability when conducting team research. This redefinition of virtuality and the integration of virtuality into a comprehensive framework of contextual factors would encourage integration of the field (i.e., virtual team and team research). As noted, most of the dimensions of virtuality proposed, except for geographic dispersion, are already incorporated in Hollenbeck et al.’s (2012) three-dimension framework. The integration of the field and the use of four dimensions to assess important contextual factors provide the best path forward for increasing our understanding of virtuality, our understanding of teams, and our ability to generalize or specify boundary conditions, and ultimately to build theory. To fully understand the complex and sometimes surprising relationships between skill differentiation, authority differentiation, temporal stability, and virtuality and their impact on team outcomes, all of these important contextual factors should be taken into account when conducting team research. Otherwise, we may continue to miss critical determinants of team interactions.

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