Perceived Discontinuities and Constructed Continuities in Virtual Work

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ABSTRACT

Boundaries such as time, distance, organization, and culture have been a useful conceptual tool for researchers to unpack changes in the virtual work environment, moving from a dichotomous perspective that contrasts face-to-face (FTF) and virtual work to a more nuanced hybrid perspective. However, researchers may tacitly assume that all members of a virtual team and virtual teams collectively will respond to a boundary in a similar way. We posit instead that boundaries are a dynamic phenomenon and may have different consequences under different circumstances. We offer organizational discontinuity theory as a tool for more focused investigation of the virtual work environment. Discontinuities and continuities describe the setting in which individuals in a virtual team operate, both actual work practices and the perceptions of the individuals in the virtual work environment. The terms offer a starting point to identify and understand what may otherwise seem to be paradoxical differences in how virtual team members respond to boundaries.

KEYWORDS: Virtual Work, Boundaries, Discontinuity, Virtual Teams

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INTRODUCTION

Virtual work is increasingly common, as globalization, advances in technology and a continuing search for economic advantage and access to expertise lead firms to employ virtual work strategies. For example, global sourcing is increasing steadily throughout firms' value chains, including outsourcing and off-shoring of knowledge work such as R&D, product design, and IT services. Contemporary work teams may include far-flung members who collaborate across boundaries of distance, time, nationality and organization.

In response to these developments, research on this topic has grown since the 1990s. In this literature, the concept of boundaries—of time, space, organization, and culture among others—has proven to be a useful tool for researchers to unpack changes in the work environment. Electronically-mediated work in practice involves teams whose members span several different boundaries and the term "virtual" has been used to describe this collection of frequently coexisting elements. Conceptualizing virtual work as work across varied boundaries moves researchers from a dichotomous perspective—simply contrasting FTF and virtual work—to a more nuanced one (cf., Powell et al., 2004, Mathieu et al., 2000). The underlying assumption of this research is that crossing boundaries creates problems for work and so the phenomenon of virtuality can be clarified through better understanding of the boundaries that must be crossed in various ways of organizing. Consistent with this perspective, studies have found that different boundaries have different effects on outcomes (Gibson and Gibbs, 2006).

Unfortunately, findings from studies on the effects of boundaries have been inconsistent: the same boundary may have different effects over time (Majchrzak et al., 2000) or may pose problems in one team and not in another (Maznevski and Chudoba, 2000). We argue that contradictory findings may arise in part because our conception of virtual work in terms of a fixed set of boundaries, while useful, is too static. Instead, we suggest viewing the problems of virtual work as a dynamic issue: many boundaries, such as culture or norms, have an evolving social nature and even those that are objectively understood by participants, such as time and space, may have different consequences

under different circumstances. As a result, boundaries, while often present, may not always be problematic for virtual work. In order to study this dynamic, we conceptualize the presence of discontinuities and continuities at a boundary, suggesting that only when an individual perceives a discontinuity at a boundary is that boundary problematic, and that developing continuities can mitigate problems associated with boundaries.

The paper continues by expanding the above discussion of the concept of boundaries in research on virtual work. Next, introduce organizational discontinuity theory contrasting boundaries with the concept of discontinuities and propose a set of propositions to describe the conditions under which boundaries create discontinuities. The paper concludes with a discussion of our thesis and its implications for research and practice.

Literature Review: Boundaries in Virtual Work Research

Boundaries are a central notion in the social sciences and are important for understanding relationships within and between systems. For organizations to function effectively there must be a "balance between differentiation and integration" of organizational systems (Schneider, 1987), implying the need for careful attention to the boundaries between units. For example, sales departments have a language and goals and objectives that necessarily differ from those in engineering departments. At the same time, these departments must be aligned to some extent for the organization to succeed. The task of integration across organizational systems often falls to individuals who serve as boundary spanners (Ancona and Caldwell, 1992). Boundary spanners coordinate effort, facilitate communication, and manage relationships in order to enhance performance within their team or organization (cf. Marrone, 2010, for a review). As we will discuss, boundaries represent both barriers and opportunities for innovation, efficient knowledge sharing, and coordination between dispersed individuals who must work together.

Virtual work in particular has often been analyzed in terms of boundaries, which have generally been understood as static demarcations that separate individuals working together, such as geography, time zones or organizational and national boundaries (Espinosa et al., 2003). Much of the early research on the virtual work environment

simply compared individuals that worked FTF with those who were geographically distributed, often through experimental comparison of individuals working together under different conditions (see Powell et al. 2004 for a review).

Beginning about 2000, researchers directed their attention to individuals in field-based studies (Mortensen et al., 2009) and soon recognized that few work environments were either totally virtual or totally FTF in practice. Researchers identified patterns of work ranging from virtual, where communication is primarily through electronic channels to FTF teams where members can easily communicate FTF, but found many settings are hybrid, in which communication is a mix of FTF and electronic communication (Fiol and O'Connor, 2005). In practice, the categories were seen as being somewhat fluid: in work settings having some type of hybrid configuration, workers vary their interactions between FTF and non-FTF communication (Griffith et al., 2003, Cohen and Gibson, 2003).

Hybrid situations have been characterized in different ways, with researchers predominately examining geographic dispersion or the amount of FTF interaction between individuals. Different work settings have been characterized by different degrees of distance between co-workers. For example, Scott and Timmerman (1999) studied teleworkers and proposed that the "percentage of one's work week spent away from the main office" (p. 245) can be used to segment workers into low, medium, and high categories of virtuality. Another strategy has been to consider the characteristics of geographic dispersion, such as totally distributed, where no members are collocated versus partially distributed, where subgroups are collocated across several locations (O'Leary and Cummings, 2007). A third technique is to examine communication patterns among members of a group and characterize the "virtualness" of a group based on the ratio of electronic and FTF communication. Niederman and Beise (1999) propose a framework where highly virtual teams are those that meet frequently through electronic media instead of in FTF gatherings, although they recognized that "fully-supported" teams might meet frequently in both modes.

Expanding the hybrid conceptualization of virtuality, researchers have developed conceptualizations of virtuality that consider the concurrent presence of multiple boundaries. For example, Zigurs (2003) examined leadership in virtual teams that exist

on a continuum of dispersion spread across many dimensions, e.g., geography, time, and organization. Boundaries have been explicitly or implicitly conceptualized as points (or areas) where differences between individuals are salient and potentially problematic, with work taking place across geographic boundaries being just one particularly visible example. Espinosa and colleagues (2003) examined boundaries they observed in five research studies of field-based virtual teams—geographical, functional, temporal, organizational, and identity (team membership). They suggest that when multiple boundaries are present, the interplay between them must be considered rather than considering a single boundary in isolation. Likewise, Orlikowski (2002) found boundaries that "members routinely traverse in their daily activities" (p. 255) to be particularly important in understanding how work was conducted in a geographically dispersed high tech organization.

This conceptual development mirrors an earlier study examining the effects of distance on organizational strategy in the context of global expansion (Ghemawat, 2001), a study that considered four dimensions of distance—cultural, administrative and political, geographic, and economic—that correspond with other conceptualizations of boundaries. Consistent with our view, Ghemawat (2001) suggested that these dimensions could have different impacts on an organization's expansion depending on the countries and industries or products involved. Two countries with different levels of consumer income would experience greater economic distance; a product vital to national security would increase administrative and political distance. Both kinds of distance could make a company's expansion more problematic. Ghemawat (2001) argued that by considering the portfolio of these dimensions at an organizational or industry-level, companies were more likely to successfully expand their operations into foreign markets.

Researchers investigating the consequences of virtuality at the individual or group level of analysis have similarly argued for different impacts of different dimensions. O'Leary and Cummings (2007) suggest separating dimensions of geographic dispersion—i.e., spatial, temporal, and configurational—from demographic dimensions, such as nationality or organization. They propose that demographic dimensions are more likely to correlate with social distance. As such, the use of ICT to mitigate negative outcomes of geographic dispersion is expected to be more effective than those associated

with demographic dispersion. Gibson and Gibbs (2006) identified four characteristics commonly associated with virtuality—geographic dispersion, electronic dependence, dynamic structure, and national diversity—and considered their impact on innovation among members of a team and found that the characteristics had independent effects on innovation.

Problem Statement

In summary, analyzing a virtual work setting in terms of boundaries has been a useful step toward untangling the complexity of the virtual work environment. Hybrid instantiations of the virtual work environment move beyond a focus on physical space to consider the interplay of multiple boundaries. While this research helps characterize the work environment, understanding of boundaries and their consequences is still in an early stage of development. We note two specific problems that we address with our theorizing.

First, the concept of boundaries provides a static view of the configuration of virtual work. In contrast, some work has described virtual work as fluid, requiring frequent adaptation to a changing environment (Lipnack and Stamps, 1997). Orlikowksi (2002) points to ongoing adjustments in her description of members of the *Kappa* organization who adapted behavior regularly, as the boundaries which they encountered (e.g., organizational, temporal and functional) were "reconstructed and redefined". Evolving work practices (Levina and Vaast, 2006) and changes in technology use (Majchrzak et al., 2000) suggest that individuals adjust their behaviors in reaction to changing conditions. Untangling when and how changes are initiated may lead us to better understand the conditions under which people are more likely to successfully perform work activities in a virtual work environment.

Second, the same boundaries have been observed empirically to have different effects in different settings, challenging the relation between boundaries and performance. For example, on the question of whether individuals in virtual teams require FTF communication, Maznevski and Chudoba (2000) and Nandakumar and Baskerville (2006) found that members should meet FTF at least early in the life of the team. But other research has found that teams comprised of distributed members can

perform effectively without ever meeting FTF (Chudoba et al., 2005, Crowston et al., 2007, McKinney and Whiteside, 2006). Table 1 highlights conflicting findings in four studies that considered the impact of cultural diversity in virtual teams. The four studies considered a common categorical boundary—culture—but arrived at different findings about its impact. One way to explain the different findings is to look more deeply at how members of the teams interacted.

Table 1. Conflicting Implications of Cultural Diversity in Virtual Teams.

Research Finding	**Example**	**Explanation**
Cultural diversity related to conflict (Dube and Pare, 2001)	Cultural differences result in differences in communication, perceptions of accountability, etc.	Individuals given cultural training so common understanding can be developed.
Cultural diversity not related to relationship and task conflict (Mortensen and Hinds, 2001)	Extent of conflict in collocated teams similar to that of virtual, diverse teams.	Teams more task-focused and do not allow spurious conflict to arise. Shared team identity leads to integrative communication, which makes it easier to overcome conflict and other problems.
Cultural diversity not related to performance (Maznevski and Chudoba, 2000)	Three global virtual teams were initially ineffective. Cultural diversity not perceived as problematic for any of them.	Two teams with greatest cultural diversity more successful because of *a priori* continuity of shared professional training (e.g., engineers) and a created continuity of predictable schedule of meetings. Third team had few *a priori* continuities and did not develop new continuities over its life.
Cultural diversity related to conflict (Kankanhalli et al., 2006/2007)	Individuals reverted to first languages during synchronous team meetings; made negative comments about team members of other nationalities.	Norms of behavior differed about appropriate meeting protocols – boundary was a discontinuity. After verbal argument, members adjusted behavior and no longer engaged in name-calling because they realized their reaction to discontinuity negatively impacted performance. Continuity of appropriate behavior in meetings developed and project completed successfully.

We suggest a root cause for these two problems is that the use of the boundary concept in previous research implicitly assumes that boundaries are always problematic for individuals and teams working across them. In contrast, we posit that people often adapt to working across boundaries and learn to do so effectively and efficiently. This perspective suggests that the conflict may not be in prior research findings *per se* but researchers' attempts to explain virtual work without examining the relational processes of adaptation that occur around a boundary. Our goal in this paper is to present a more dynamic view of boundaries by introducing the notion of discontinuities and continuities as a way to focus on the relational context of the work setting. In the following section, we explore the effects of boundaries in more detail to justify this shift in conceptualization.

THEORIZING BOUNDARIES VS. DISCONTINUITIES

Boundaries are important because they distinguish one domain or situation from another, ordering and simplifying the environment (Ashforth et al., 2000). Recognizing what is inside and outside of boundaries helps individuals decide where to focus their attention and how to access needed resources. Common understanding of behavioral rules and expectations within the boundary generates feelings of identity and a sense of membership (Lamont and Molnar, 2002). Paradoxically, coherence within a boundary can lead to difficulties when individuals must work across boundaries. The team boundary spanning literature offers useful insights to this challenge. Members of teams must maintain effective internal routines and processes in order to succeed at the same time that they facilitate knowledge exchange and coordinate activities across one or more organizational functions, or even multiple organizations (Ancona, 1990, Marrone et al., 2007, Marrone, 2010). Boundary spanning activities are not always successful and may even impede a team's efficiency or effectiveness (Ancona and Caldwell, 1992), especially as individuals try to navigate between internal and external demands (Choi, 2002, Marrone, 2010).

Boundaries are reified and solidified through the actions, behaviors, and beliefs of those within a specific context or domain. The actions of individuals who work within a boundary are integrated (Schneider, 1987, Ashforth et al., 2000) and form a coherent set

of structures reflected in social practices (Orlikowski, 2002). The structures that underlie integrated actions of behavior may be tacit, commonly understood ways that things are done, e.g., "In our company, we ….", or they may be explicit practices, such as administrative policies and procedures in organizations or laws in a country.

Levina and Vaast (2006) describe this phenomenon in their study of an IT development team and how its work practices were transformed. Initially, clients and developers brought different practices and understanding of expected behavior on the team from their previous work contexts. Their expectations differed as to how the team's work should be done on the project, which created conflict and tension. Similarly, cross-cultural teams may have members whose work habits are influenced by different local expectations that create conflicts between members; e.g., Americans may sacrifice weekends while those in other countries have different practices regarding the division of work and personal life (Bjørn and Ngwenyama, 2009). Until actions are taken to structure a common set of work practices among the individual members, the teams will experience conflict (Bjørn and Ngwenyama, 2009, Levina and Vaast, 2006, Orlikowski, 2002). By extension, work that spans boundaries – that is, virtual work – can be expected to encounter problems from the differences in the spanned settings.

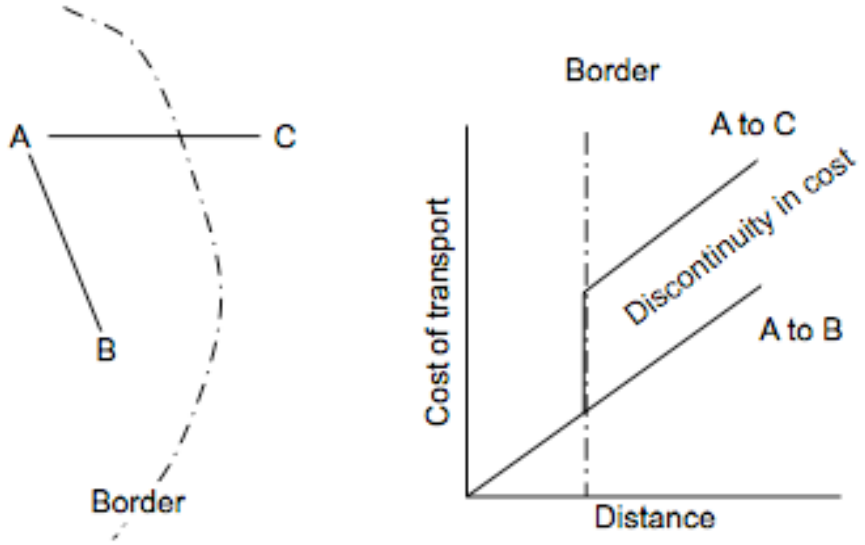
Separating Boundaries and Their Effects

To understand how people adapt their behavior to work with those in a different domain, we argue that it is necessary to separate the effects of the boundary from the boundary *per se*. To illustrate the difference, we draw on work in economic geography by Nijkamp, Rietveld and Salomon (1990) on the effects of national borders (a boundary) on physical flows of products across space. They note that the existence of a border can be seen as a jump in the cost of flows at the border. For example, moving products from one nation to another can incur costs due to waiting time and administrative activities at the border. The result is a discontinuity[1] in travel costs, which rise with increased distance but jump discontinuously when the border is crossed, as shown in Figure 1. The cost of transportation between a starting point A and two equidistant points B and C is different because of the presence of a border between A and C that requires a different set of

[1] Note that this use of the term discontinuities refines the usage of Watson-Manheim et al. (2002) by detailing a source for the problems.

activities to address the disruption of travel at the border crossing that raises the cost of transportation.

Figure 1. Boundaries and discontinuities in geographical space



The exact costs incurred depend on numerous circumstances. The borders between U.S. states and between many European nations are still borders but generally speaking do not create disruptions to travel, meaning that a discontinuity in travel costs does not exist. Furthermore, costs may change over time: for example, the barrier to travel imposed by borders between many countries in the European Union has dramatically reduced in recent years. Finally, the cost of a border crossing is not necessarily the same for all travelers, as specific circumstances may mitigate problems experienced at a border. For example, the United States and Canada have developed a process to make crossing the border easier for commuters. These frequent travelers can submit an application to the government and receive a pass that enables travel across the border in a special commuter lane. As a result, the border is perceived as less problematic; crossing it becomes a relatively unremarkable occurrence.

Effects of Boundaries in Virtual Work

The previous discussion provides an example of the separation of a boundary from the effects of crossing a boundary in physical space. Returning to virtual work, we suggest that individuals performing joint work activities that cross a boundary may

similarly be subject to disruptions to information and communication flows as compared to work activities that do not cross a boundary; that is, they may experience a discontinuity in the performance of joint activities, a break in information and communication flows that requires them to commit additional attention and effort to manage the situation. In both the physical and virtual cases, behavior must be adapted at the boundary to address the disruption.

There is a key difference between physical and information flows that requires further discussion. Specifically, disruptions to the flow of physical goods at a border crossing are typically apparent and clearly observable even to those who are not directly involved, as is the need to initiate activities to handle the disruptions. On the other hand, disruption to the flow of information and communication between individuals may be apparent only to those directly involved and may have no immediately observable consequences. Given the possibly tacit nature of the discontinuity, individuals involved in boundary spanning work must recognize the disruption and direct attention to understanding or interpreting the situation in order to adapt their behavior.

We therefore propose that, in a virtual work environment, a *discontinuity* is created at a boundary when an individual perceives a change in information and communication flows that requires conscious effort and attention to handle. Important in this definition is the requirement that a disruption exists *and* that involved individuals recognize the disruption. Indeed, rather than creating a discontinuity, people may make sense of problems by viewing them as exceptions or anomalies, not as a result of the situation of working virtually, meaning that no discontinuity is perceived. Someone with significant experience in virtual team work may attribute problems that result from boundary conditions (e.g., misunderstandings regarding work assignments) as due to personal shortcomings of a specific teammate (Cramton, 2001) rather than as a discontinuity to be addressed. Thus, when working across boundaries, if flows of communication and action are as expected or require minimal attention and effort to manage, then the situation is perceived to be ordinary, i.e., a discontinuity does not exist. A recent review of 97 empirical studies of virtual teams published between 1990 and 2008 found that an emergent state characterized by shared mental models and understanding of the task leads to improved performance and productivity (Mortensen et

al., 2009). Reliable expectations and "habits of the mind" simplify the work environment and allow individuals to focus energy and attention on the content of their work practices (House et al., 1995), rather than negotiating and interpreting behavioral rules.

Conceptualizing virtual work in terms of discontinuities and continuities addresses the two concerns noted above. While boundaries can be similar across multiple situations, discontinuities and continuities are much more context- and situation-dependent, providing a way to address the discrepant findings in the literature. Furthermore, the status of a boundary as creating a discontinuity is subject to change, enabling a dynamic view of its impact. A new set of structures for action can emerge to address the unexpected disruptions at the boundary, enabling activities crossing the boundary to occur in an expected fashion and with minimal additional attention. These new routines or understandings of expected actions serve as a *continuity* that reduces or eliminates the problems associated with the boundary (i.e., the discontinuity); the additional attention and effort required to understand and manage the situation when it was initially perceived is reduced.

We illustrate this approach with an example from the literature on virtual work. Maznevski and Chudoba (2000) described a team formed around a strategic alliance between two multinational organizations whose task was to service a volume sales agreement and facilitate the development of new technology. Unfortunately, the team faced a problem with capturing the attention of members spread across two continents, with the U.K. sales manager responsible for managing the contract repeatedly frustrated with getting the attention of members located at headquarters in the U.S. In our terms, the many boundaries between the team members created noticeable problems in information flow and joint work, creating discontinuities in the work.

It was only when the contractual agreement appeared to be falling apart that top management reorganized the team, assigning a senior HQ manager to the team. This person instituted regular same-time gatherings, both via conference call and FTF, between the company and its customer, and this, along with the senior manager's authority, ensured that team members maintained appropriate focus on the team's task. The regular meetings were an important initial practice that helped overcome the discontinuities the team faced. They became a routine practice and provided stability for

the team, but at the same time allowed the team to identify and negotiate changes as they arose (Maznevski and Chudoba, 2000). Knowing that regular conference calls would take place gave team members a time and place to negotiate conflicts or differing priorities. Further, the documentation from these meetings and established expectations of accountability led to confidence in future problem resolution. The routine enactment of the initial procedure, monthly telephone conference calls, led to a change in understanding of the team's rules for behavior and allowed the team to adapt and align its actions to more effectively support operation of the strategic alliance. New structures – that is, continuities – emerged to address discontinuities that troubled virtual work.

Perceptions of Discontinuity

We have argued that boundaries create discontinuities in joint work when an individual encounters a situation in which normal and routine behaviors do not produce expected action responses and flows of information. In other words, not only must the situation be discrepant it must also be recognized or experienced as such (George and Jones, 2001, Louis and Sutton, 1991). But under what conditions would we expect a discontinuity to be perceived and to lead to changes and development of a continuity? We address this question next.

Routine work relies on reliable expectations and "habits of the mind" simplify the work environment and allow individuals to focus energy and attention on the content of their work practices. Contrariwise, encountering a discontinuity will trigger an individual to move from a relatively automatic mode, where interactions and activities are expected and unremarkable, to a more attentive and reflective mode of thinking that may lead to changes in behavior to address the discontinuity. To explore this notion of moving from a relatively routine behavior to a more conscious and attentive state, we draw on research on "triggering conditions" (Griffith, 1999) and "cognitive switching" (Louis and Sutton, 1991).

Louis and Sutton (1991) address the movement between "automatic cognitive modes" and "conscious cognitive modes" of thinking. Their work is grounded in a long line of evidence, beginning with Leon Solomons and Gertrude Stein in 1896, that much of the time individuals rely on "'habits of mind' to guide individual interpretations and behavior" (p. 55). There is also clear evidence across multiple fields that individuals

engage in conscious modes of thinking, i.e., where there is active awareness, attention, and reflection. The authors state:

> This view of 'switching cognitive gears' ought to be applicable whether one adopts an information-processing, script-processing, schema-based, or other model of cognitive functioning. Invoking a particular cognitive model would detract from the dynamics of the switching process which are the focus and contribution of this work. Therefore we discuss the two cognitive modes as automatic and conscious, contrasting reliance on habits of mind with active thinking (p. 57).

This work identifies three types of situations where 'switching' occurs (Louis and Sutton, 1991, Griffith, 1999):

1. *Discrepancy*: when one encounters a *discrepancy*, an unexpected failure, a significant difference between expectations and reality.
2. *Novelty*: when one experiences a situation as unusual or novel, something out of the ordinary.
3. *Deliberate Initiative:* a deliberate request for active thinking, usually in response to a request for an increased level of conscious attention, "when people are asked to think, explicitly questioned or when they choose to try something new".

These conditions are summarized in Table 2 and examples of their applicability to virtual work are discussed in the sections below.

Table 2. Conditions under which discontinuity is perceived.

Condition	**Definition**	**Example Situation**
Discrepancy	Individual perceives situation as significant difference between expectations and reality	New member from Europe is added to distributed team that previously had members from multiple sites in U.S.
Novelty	Individual perceives situation as unfamiliar or previously unknown	Global product development team with members from multiple countries and functional areas is implemented in multi-national organization
Deliberate Initiative	Individual responds to external stimulus to actively evaluate situation and adjust behavior	Cross-cultural training is conducted proactively for employees who will work with offshore IT vendors in

where suitable India

The first trigger is recognition of a significant difference between expectations for work and reality. When usual actions do not produce expected results, that is, when there is a discrepancy, individuals will be motivated to examine the work situation and vary their actions to reduce the discomfort or difficulty of the situation (George and Jones, 2001 2001). This process may be relatively simple or may be difficult depending on *a priori* differences between team members (Gabarro, 1990).

For example, in a virtual work environment, it is relatively easy for a new member to be added to a distributed team, e.g., the person may simply need to be added to the email list for the team. However, the addition of even a single new member may seriously disrupt the existing team's work practices. Consider a distributed team that adds a person whose first language is different from current members. An existing practice had the team leader send a short email summary of the meeting to participants listing decisions made and specific actions plans. Such a message might be too terse for a non-native speaker who had trouble following the discussion during the meeting, leading to misunderstandings and missed assignments. In response, the team leader could try a new practice of sending a more extensive email message documenting specific agreements and actions.

In this case, the trigger for the team leader to change her established pattern of behavior was a discrepancy in the behavior she expected of team members. When she recognized the discrepancy, the leader focused attention on the situation and surmised that the difficulty in the team's performance was due to misunderstanding by the new member. She then varies her usual practice and observes the results of this change.

While the discrepancy may lead to new behaviors, a continuity is established only when new practices are adapted and repeated. As new behavior patterns are carried out, and the results are observed to be satisfactory, these behaviors are likely to be repeated when facing a similar situation (George and Jones, 2001). By repeating reactions to specific circumstances, behavior patterns become predictable and reactions of partners are expected. Over time, repeated and successful actions lead to a change in understanding of the normal and expected work practices (Feldman and Pentland, 2003).

In our example above, if the team leader perceives her action to have mitigated the difficulty, if this new practice enabled the new member to integrate well into the team and interactions and performance improved, then the leader would be motivated to continue the new practice. Over time, as she repeats this action under similar circumstances, she and the team members change their understanding of expected behavior in this situation. Team members may now come to expect a more extensive email from their leader after each meeting and find that the more comprehensive documentation reduces the chance for misunderstanding. With this new practice, accommodating the new member now requires little extra attention by members or the team leader; they have developed a continuity that enables activities at the boundary to occur in an expected and ordinary fashion. Members of the team develop revised expectations about behavior in the situation and are able to function in a relatively automatic mode because of the emergent continuity, allowing them to focus on the content of the work rather than the process.

Contrariwise, the changed behaviors might not be repeated for a number of reasons. First, the new behavior may not be perceived to mitigate the problem, rightly or wrongly. While the experiment might in fact not work, it is also the case that people can "rationalize discrepancies to the point where they are actually seen as supporting one's expectations" (George and Jones, 2001). A person who may be skeptical about working virtually may rationalize a problem as being inherent in this environment and problems he encounters reinforce his expectations, thus discouraging attempts to address the problem. Second, because established structures are resistant to change, behavioral changes may be resisted and not repeated. Finally, individuals will not continue to try new behaviors indefinitely. Over time, if the behavioral trials are not successful in addressing the discontinuity, other more pressing matters may take precedence (George and Jones, 2001). For a variety of reasons, individuals may be dissatisfied with responses to a behavioral trial and choose not to repeat it, failing to create a continuity to support virtual work and leaving the discontinuity unsuccessfully addressed.

In summary, we suggest that if a set of actions is perceived to be successful, i.e. it reduces the discontinuity in the carrying out of joint work activities, it is more likely to be

repeated when similar conditions are encountered in the future. Adapted behaviors that are not perceived to be beneficial are less likely to be repeated in the future. We propose:

P1: Adjusted behaviors that are perceived to reduce the problems associated with a discontinuity are more likely to be repeated.

P2: Adjusted behaviors that are perceived to reduce the problems associated with a discontinuity and are repeated over time become expected and ordinary, i.e., a continuity is developed, resulting in the boundary being unproblematic.

Visibility of Boundaries and Planned Continuities

In our discussion thus far, we suggest that individuals initiate changes in behavior when a discontinuity is perceived, rather than when a change in boundary conditions is perceived. The individual may or may not be aware of the boundary but will be aware of the discrepancy, the discontinuity, leading to the adaptation process discussed above. It is also possible that the individual perceives a change in boundary conditions and consequently pays heightened attention to the situation *prior to* experiencing a discontinuity. In this section, we discuss this possibility.

In Louis and Sutton's (1991) model, this situation involves conscious attention due to a deliberate plan or sparked by recognition of the boundary as a novel situation. Recent research has highlighted the importance of devising appropriate interventions for new practice fields (Levina and Vaast, 2006), including the responsibility of leaders of virtual teams to use technology facilitation to develop common work practices around ICT use (Thomas et al., 2007). Understanding conditions that stimulate the development of continuities to reduce impediments on information and communication flows among those engaged in virtual work is necessary for successful team functioning.

An example of this process was described by Maznevski and Chudoba (2000). Their study described the MakeTech team, initiated to manage a strategic alliance with a European competitor to co-develop products using components from each company, with joint distributorship and cross-selling agreements. This alliance was the first such arrangement for each partner and they recognized that this novel situation would require new procedures. As a result, the initial organizing process was very deliberate, with frequent FTF meetings at various sites in Europe and North America and high volumes of communication using numerous media between these meetings.

Some of the most difficult dilemmas were resolved over a long period of time, using multiple team members and technologies. For example, between FTF meetings an issue arose concerning which types of sensitive quality control data would be shared between the two competing companies. There were strong disagreements about what the original commitment had been. Team members established a practice of frequent and well-documented communication using multiple channels, which kept everyone focused on the problem. This practice also helped ameliorate challenges around different first languages of members and different legal environments in which the two companies operated. Eventually, individuals identified the source of miscommunication and disagreement, and found a solution that involved sharing certified summaries and conclusions rather than specific data. The successful practices associated with solving this problem were then replicated as new challenges arose.

The final trigger for explicit thinking is a deliberate initiative to create new practices. At Intel Corporation, employees routinely work and collaborate with colleagues around the world and meetings are frequently enabled by the use of ICT in order to support the formation and work of these virtual teams (Chudoba et al., In press). Because of the pervasive nature of virtual teams at Intel, the Human Resources department has drawn on research to suggest best practices that members of virtual teams are encouraged to follow, proactively attempting to change work practices.

In these two cases, we suggest that the visibility of the boundary will affect the likelihood that it triggers active thinking and so development of continuities. The process of developing continuities may be mediated by the degree to which people are aware of and attentive to boundary conditions and possible resultant consequences. To the extent that the situation seems novel or the invitation to think reflectively is adopted, the group may develop new continuities. In the following section, we discuss different categories of boundaries which vary in their degree of visibility, or the degree to which the boundary is obvious, commonly understood and anticipated: physical boundaries, administrative boundaries and categorical boundaries.

Physical boundaries are the most evident boundaries and also relatively unchangeable. Physical boundaries are material differences, e.g., geography and time. Geography has long been concerned with physical distance and the movement of people

or goods. Geographic distance can also encompass differences in time, which for the most part, are also invariant and measurable. The need to span geographic differences is apparent to those managing and working in a virtual environment. In this case, the boundary may be perceived and changes initiated *prior to* the discontinuity being experienced. Spanning geographic boundaries may lead to increased levels of cognitive attention because individuals are aware that they will need to give careful consideration to the context of their work environment and to the actions and reactions of co-workers.

Administrative boundaries do not have material components but have a recognized and agreed upon legitimacy that has been conferred by some authority in the community[2]. For example, the boundaries of business organizations have a legal basis and the demarcation between organizations is obvious. Because administrative boundaries are conferred and legitimized by some authority, they are relatively stable. Nations have rules of law, organizations have policies and procedures, and formal organizational units have incentives, performance goals, and reporting structures. In addition, these boundaries are usually apparent and commonly understood by those working in a virtual environment.

We label the third type of boundary as a *categorical* boundary. Categorical boundaries are distinctions made by individuals to classify people, such as religion or economic class or the shared background and experience of college alumni. In general, these boundaries are most apparent to those within the boundary and, in comparison to geographic and administrative boundaries, are less visible to those outside of the boundary. They may often only become apparent after some conversation or information exchange between individuals. For example, the use of certain communication media may provide information to establish gender, e.g., communicating via video conferencing could provide visual evidence or use of a teleconference could provide auditory evidence of gender. The use of asynchronous media could also provide this evidence, e.g., the name of the individual could indicate the gender. However, many names are used by both genders, e.g., Michele or Cameron in U.S. or European countries, and the gender usually associated with names from one culture may not be obvious to those who are not familiar

[2] Our use of the term 'administrative' to describe this type of boundary has some similarities to use by Ghemewat (2001). However, we use the term in a more narrow sense at an individual level while he focuses his discussion on broader differences between sovereign nations.

with the traditions (e.g., Devahuti is a female name in India but this is probably not obvious to those outside of India). Thus categorical boundaries are likely less obvious to those working in a virtual environment, making it less likely that individuals will proactively work to address potential discontinuities.

Clearly, these three types of boundaries are not independent. Geographic boundaries often overlap with administrative boundaries, such as national borders. Organizations are located in countries and have operating procedures that are influenced by the laws of that country. Within administrative boundaries, countries, organizations or teams can have emergent boundaries that guide actions and beliefs of members. However, to the extent that a boundary is more visible, individuals are more likely to expect discontinuities to ensue prior to interacting with others across the boundary or otherwise experiencing work across the boundary.

P3: The more visible and obvious a boundary, the more likely that those who work across the boundary will anticipate discontinuities and be proactive in addressing them.

ICT Use, Discontinuities and Continuities

In this final section, we discuss the problem of the use of ICT and its relation to boundaries in a virtual environment. Most researchers, explicitly or implicitly, assume that the use of ICT enables work to take place across boundaries. Indeed, use of ICT is sometimes included in the definition of virtual work. In our language, such uses of ICT might be seen as reducing the effort required to perform work activities across boundaries, that is, as creating continuities. We suggest, however, that simply because use of ICT enables individuals to work with others in a virtual team does not mean that ICT necessarily serves as a continuity for the team: if use of ICT creates a disruption in how individuals in the team work, then the ICT creates discontinuity. Research has found just this outcome when the technology and needs of a team are not aligned (Majchrzak et al., 2000). Surprisingly, there is little research examining specifically how, when, and under what conditions ICT is used and what specific features of ICT are perceived to support or disrupt the joint performance of distributed work activities.

Organizational discontinuity theory provides a means for beginning to investigate this phenomenon. We note that the meaning and understanding of capabilities of ICT can

differ across groups. Features of technology can trigger sensemaking and serve as the foundation for developing understanding (or disrupting previous understanding) of appropriate usage (Griffith, 1999), and usage patterns and understanding of media can be constrained or facilitated by material characteristics of the medium (Orlikowski, 2000). This suggests that the perceived usefulness of ICT (either a particular medium or combination of media) at a boundary is not static and can vary across different situations.

In Table 3 we examine two communication media, email and desktop video conferencing, separating their core features. We illustrate how the same medium may be perceived differently across boundaries, and as a discontinuity or as a continuity at the same boundary. For example, email is an asynchronous communication medium, which facilitates working across time zones; however, the very same features can create disruption to work by introducing delays in responses, leading to a discontinuity.

Table 3. Illustration of email and desktop video conferencing as continuity and discontinuity

Features of the medium	**Boundary**	**Continuity**	**Discontinuity**
EMAIL			
Asynchronous communication	Time	Time zone differences become less important	Lag time between interaction goes up
Text-based	Language	Non-proficient English speakers may prefer text-based communication instead of verbal communication	Narrow medium that can exacerbate effects of language differences
Message is stored, can be saved, retrieved, forwarded to others	Nationality, Language	Can lessen effects of language differences when people have time to reflect before reacting, e.g., can re-read for better understanding	Reader may react to misunderstood or poorly worded message by forwarding to others, escalating the misunderstanding
Threads of multiple messages can be saved, retrieved, forwarded to others	Geography	Helps establish common understanding of message context	Can contribute to lack of trust when users forward messages not intended to be shared
DESKTOP VIDEO CONFERENCING			
Synchronous	Time	Provides immediate	Time zone differences

communication		feedback	matter
Higher bandwidth medium	Nationality, Language	Questions can be asked, issues clarified in real time	Effect of language differences may be heightened, flow of interaction may be disturbed
Session can be stored, saved, retrieved, forwarded to others	Language	Can be replayed for better understanding	People may hesitate to be honest when session is being recorded

Similarly, use of a particular ICT may be pervasive within a group but not outside the group, leading to the perception of a discontinuity. For example, researchers who studied meetings at Intel found islands of technology support (Chudoba et al., In press). Intel members of the team relied on a particular system to support virtual meetings, but the company firewall made the system difficult or impossible for non-Intel employees to use. As a result, attempts to use the system with cross-organizational groups ran into technical problems, creating a discontinuity in those interactions.

Our model suggests that the disruption users perceive during ICT usage at a boundary creates a discontinuity, potentially leading to changes in the use of the medium through the adaptation process described above. For example, with regards to email usage, if the team is to succeed, members must learn which interactions are likely to require synchronous interaction and which can use asynchronous media. To cope with time zone differences, many distributed teams members find that they must work non-traditional hours to be able to attend synchronous meetings. In this way, variation in media use can ultimately lead to the formation of new usage routines and understanding of media capabilities (Orlikowski, 2000, Watson-Manheim and Bélanger, 2007). These new routines, or a shared context of ICT use, enable ICT to serve as a continuity for members of a virtual team.

Thus, we propose:

P4: The use of ICT contributes to a continuity at a boundary only when individuals in a workgroup develop shared structures to guide its use.

DISCUSSION

Our basic proposition is that boundaries, while ubiquitous in virtual work, are not necessarily problematic for all groups all the time. Researchers interested in understanding virtual teams and managers trying to optimize their performance must investigate in more detail how work crosses boundaries. Rather than simply identifying the boundaries crossed by members of a team, researchers and practitioners must delve more deeply into the details of how members respond to working across boundaries. Discontinuities and continuities describe the setting in which individuals in a virtual team operate, both actual work practices and the perceptions of the individuals in the virtual work environment.

We now consider the implications of our ideas relative to prior research and develop possible avenues for future research. Specifically, we consider how the language of discontinuities and continuities extends prior research in two areas – the boundary-discontinuity relationship and responses to discontinuities – along with methodological implications.

Research Direction #1: Boundaries and Discontinuities

Our first question relates to the differences among different kinds of boundaries. Using as an example the boundary most commonly associated with virtual work, distance, researchers have demonstrated that individuals working virtually respond to distance differently. While distance is a highly visible boundary, it may not be the actual boundary that poses challenges, or a discontinuity, to individuals in a virtual work situation. For example, individuals working temporarily on-site at a partner company may actually have more common expectations and understanding of work routines with distant team members from their own company than with collocated team members from the partner company (Wilson et al., 2008). Such shared expectations around work practices serve as continuities and make it easier for members to perform more effectively than one might expect given the boundary of distance.

Describing the situation in terms of discontinuities and continuities does more than offer new language to explain the paradox of proximity identified by Wilson and colleagues. It also alerts researchers and members of virtual teams to the possibility that

the paradox may be relevant to boundaries other than distance. For example, Bjørn and Ngwenyama (2009) found that although collocated meetings have been identified in numerous studies to be critical for the success of distributed teams, they can actually lead to communication breakdowns under certain circumstances, e.g., when all team members are not equally conversant in English (even though English may be the language of the firm). Future research in this area could consider the following questions: *Under what conditions are boundaries perceived as discontinuities? How does the visibility of a boundary (e.g., how easy it is to distinguish) affect the perception of a discontinuity?*

Beyond challenging assumptions about how to investigate boundaries, it may be instructive for researchers to investigate structural differences in discontinuities and distinguish between those that can be relatively easily managed and those that are more significant and have substantial effects. Differences in task characteristics, especially those that have a communication component, may have an effect on the perception of discontinuities or continuities. For example, jobs that are not predictable require more communication with co-workers to gather information and solve problems than jobs that are predictable (Rice, 1992). As a result, the same boundary may have more problematic effects, more discontinuities, for the performance of unpredictable and highly interdependent tasks than for simpler tasks. Researchers may need to examine the actual content of the work in more detail to identify such effects. Questions researchers might address include: *How does a team's task affect members' perception of discontinuities? How can tasks be structured to enhance the development of continuities?*

Research Direction #2: Responses to Discontinuity

Our second discussion point concerns the response to a perceived discontinuity. Of what value is it to conceptualize boundaries as discontinuities or continuities? On the surface, this language suggests that it is best to think of all boundaries in a similar way rather than consider them distinct conceptual and empirical phenomena. That is not our intention. Again using distance as an example, researchers have demonstrated that individuals working virtually respond to distance differently. The difference might be because team members are not all located the same distance from each other (cf., O'Leary and Cummings, 2007) or because there is another boundary such as shared work practices that is more salient than the boundary of distance (cf., Wilson et al., 2008). The

language of discontinuities and continuities provides a pair of concepts to begin an investigation of such differences. It encourages researchers and practitioners concerned with virtual team effectiveness to focus on how individuals respond to a given boundary and why, without the assumption that all members or that all virtual teams will respond to a boundary in a similar way. A boundary may be perceived as a discontinuity by some members of a team and simultaneously be perceived as a continuity by others. Further work could explore the following questions: *What kinds of discontinuities characterize different kinds of virtual work? What differences among teams and team members explain different responses to these types of discontinuities? Under what conditions might individual team members differ in their perceptions of discontinuities? Must continuities always be developed in response to discontinuities in teams that operate effectively?*

Responses may also vary over times, as argued by Pickering (1995). He noted that collaborators operate in different ways at different times and as a result their interaction with team artifacts such as technology is an emergent phenomenon. Similarly, Putnam and Stohl (1990) suggest that through interaction, continuously challenged boundaries become more fluid. The language of discontinuities and continuities helps to capture this sense of a dynamic boundary as perceived by individuals working in a virtual team. As the dynamics of the relationship between members emerge over time, the perceptions of a boundary as an artifact of team interaction changes. Conceptualizing boundaries in the workplace as a more fluid phenomenon rather than one that is dichotomous highlights a benefit of our discontinuities and continuities perspective. Further research could investigate the following questions: *Are there temporal markers that correspond to changes in how a boundary is perceived? Are specific types of interaction associated with changes in how a boundary is perceived? How does the passage of time serve to hinder or enhance the development of continuities?*

Researchers have recently begun to examine situations where members of teams deal with multiple boundaries concurrently. Espinosa and his colleagues (2003) caution researchers to take into account the presence of multiple boundaries and the effects of possible interactions between these boundaries in studies of virtuality. Combinatorial effects are also important because of the rising incidence of multi-teaming. Work across multiple boundaries may be the norm rather than the exception among knowledge

workers today. While a single boundary may not be perceived as problematic—i.e., not perceived as a discontinuity—the interaction between multiple boundaries may result in the perception of discontinuity.

From an individual's perspective, discontinuities are not necessarily managed the same way across all teams. Continuities in practice for one team may be different from the practices of another team, leading to discontinuities across teams for an individual who has to work with both. The team itself may become another boundary to the individual working on multiple teams and may be perceived as a discontinuity. Lu and colleagues (Lu et al., 2006, 2005) found that differences in work practices across teams had a negative impact on the performance of individuals who were members of multiple teams. To the extent that different teams have different practices and use technology differently, people who work on multiple teams concurrently may be at a disadvantage as they may be more likely to experience discontinuities and resultant negative effects on performance (O'Leary et al., 2008).

By examining boundaries in terms of discontinuities and continuities one can project the conditions under which they produce independent and differential effects on outcomes such as innovation (Gibson and Gibbs, 2006) or team performance (Lu et al., 2006). When colleagues who work together across a boundary perceive a discontinuity, some other boundary condition may allow common ground to quickly negotiate differences and align behavior. Future research in this area could investigate the following questions: *Do discontinuities across teams in which an individual plays a central role have a stronger effect on productivity than discontinuities across teams in which an individual is a peripheral member? What types of continuities are associated with the effective performance of individuals who work on multiple teams?*

Research Direction #3: Methodological Issues

Finally, our basic proposition—that not all boundaries are problematic all the time—raises several methodological points about how to study virtual work. First, to identify the nature of the particular discontinuities faced in a particular setting, it is important to look in detail at the specific work practices in studying virtual work and the perceptions of that work by the individuals involved. Second, longitudinal examinations of those engaged in virtual work are important in order to capture changes over time in

the perception of boundaries, and more specifically, the development of continuities. Finally, the discontinuities/continuities framework highlights the need for cross-level research. While the team itself may not face different dynamics, the individuals within these teams may be navigating a more complex environment, especially if they are members of multiple teams concurrently. Since the performance of a team is dependent on each individual's performance, multi-level models that consider an individual's perceptions of discontinuities as well as the presence of continuities at the team level may help us better understand the impact on individuals who manage multiple contexts. At the organizational level of analysis, researchers might build on Ghemawat's (2001) examination. Specifically, researchers can consider the following: *How does one measure an individual's perception of discontinuities and continuities? How can the perceptions of individual team members be compared or synthesized at the team level to allow meaningful analysis?*

Managerial Implications

In addition to its value for researchers, our perspective has implications for practitioners. A first implication is that focusing primarily on the boundaries a team crosses may not be sufficient, as the problems stemming from the boundaries may change from team to team or change over time within the same team. Instead, the focus should be on building shared practices or common expectations for practice within a team, that is, on creating continuities to support shared work or setting incentives for team members to build continuities themselves. These continuities could take the form of meetings at regular intervals (e.g., Maznevski and Chudoba, 2000) or expectations about response times for email messages (e.g., Watson-Manheim and Bélanger, 2007). Also, managers should identify the areas over which they have control and attempt to develop continuities at these boundaries. For example, in cross-organizational teams, the priorities of people in different organizations are beyond a particular manager's control, but the team can be encouraged to create work practice continuities.

While addressing a discontinuity may require additional effort initially, shifting from discontinuity to continuity can lead to innovation in work practices. Because of the constant exposure to new ways of thinking and re-definitions of action routines in discontinuous work environments, these changing relationships can enhance an

individual's and through them, the organization's innovativeness. The possibilities of the virtual environment may stimulate positive emotions such as encouragement or hope that can stimulate behavioral change (George and Jones, 2001) or innovation when work is conducted in a psychologically safe communication climate (Gibson and Gibbs, 2006). On the other hand, since individuals working together may not share common vocabularies, assumptions, norms, schemas, and so forth, they may find it difficult to understand each other, or worse, believe that they understand each other while remaining oblivious to the presence of misunderstandings. Practitioners should be aware of this possibility and focus on identifying and managing its consequences.

CONCLUSION

Prior research has identified many challenges to work in virtual settings, but guidance on how to achieve positive work outcomes is sometimes contradictory as researchers highlight different problematic aspects of virtuality. We suggest that this inconsistency is because the boundaries that characterize virtual work—time, space, culture, organization, and so forth—are objective demarcations that are not uniformly problematic. It is only when those working in virtual settings perceive a boundary to be a discontinuity that it hinders work processes. Further, what is perceived as a discontinuity at one point in time may not be perceived as a discontinuity at another time. Continuities, or equivalent expectations across members of a group, are a construct distinct from discontinuities and are necessary for successful work in the virtual environment. They may be present when members of a group first begin to work across boundaries. Alternatively, continuities may be created through deliberate management or group member intervention or emerge as members work through problems arising from the presence of discontinuities. Consideration of which boundaries are perceived as discontinuities by members of a virtual team and which are addressed by continuities serves as a foundation for understanding the dynamic nature of the team's practices. Organizational discontinuity theory highlights the importance of looking at not only specific work practices but also the larger on-going context in which the work takes place. It does not mean that we no longer need to investigate how boundaries are different; rather, the language of discontinuities and continuities offers a way to focus

that investigation. In sum, we believe that discontinuities and continuities provide a way to initiate one's investigation of work in virtual teams, and are complementary to the need to understand distinct effects of boundaries and the circumstances under which those effects may occur.

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