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Boundary Transitions in Dynamic Teamwork

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BOUNDARY TRANSITIONS IN DYNAMIC TEAMWORK

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ABSTRACT

We develop a theoretically grounded framework of boundary transitions and their effect on individuals working in dynamic teamwork settings. Boundaries in teamwork, described here as the psychological limits that define one team as separate from another, have been examined in silos across a broad range of literatures. Consequently, we know little about the cognitive processes associated with the psychological shift in focus (or boundary transition) that occurs because of a change in people, roles, tasks, or technologies in the context of dynamic teamwork. Our comprehensive model of boundary transitions incorporates a broader perspective of boundary transitions, such as transitions across multiple types of boundaries, as well as dimensions of boundary transitions, such as the strength and meaning of the boundaries traversed, the number of boundaries crossed (transition breadth), and whether the context of the transition is within or between teams (transition context). We leverage this framework to explore the cognitive implications of boundary transitions (cognitive exertion and expansion) as well as their implications for individual contributions to teamwork and provide an agenda for future inquiry in boundary transitions in dynamic collaborative teamwork.

BOUNDARY TRANSITIONS IN DYNAMIC TEAMWORK

Today's dynamic, collaborative workspace requires people to engage and disengage, to orient and reorient, to lead and to follow, and to do so in terms of the people they work with, the tasks they engage in, the roles they adopt, and the technologies they utilize. Transitioning across these different boundaries can be a challenging process, as it requires individuals to mentally shift gears and adjust their attention to a new set of demands and social dynamics. Individuals must be able to manage their time and prioritize work, while also being able to maintain a high level of mental flexibility and adaptability. These types of experiences push our traditional understanding of what it means to work collaboratively. Accordingly, scholars have begun to investigate ways in which contemporary teamwork departs - at times - considerably from this traditional definition (e.g., Hackman & Katz, 2010; Wageman et al., 2012). Instead of clearly defined and bounded membership, many of today's teams are better conceptualized in terms of the extent of (1) member participation (which may vary both within and across members; e.g., Arrow & McGrath, 1995; Dibble & Gibson, 2018; Edmonson, 2012; Summers et al., 2012), (2) membership overlap (as individuals are often members of more than one team; e.g., Bertolotti et al., 2015, Cummings & Haas, 2012, O'Leary et al., 2011), and (3) member dispersion (since members are often dispersed geographically and functionally; e.g., Cramton, 2001; Cummings, 2004; Gibson & Gibbs, 2006).

Beyond changes with whom one is working, changing from one team to the next may *also* constitute changes in tasks (e.g., from one project to another), roles (e.g., from a contributing software engineer to a leadership role in the employee resource group), and technologies (e.g., from one data processing program to another). Moreover, the nature of these transitions varies in terms of their frequency, complexity, and meaningfulness. For example,

employees in any one of the major tech organizations - Apple, Google, Meta, Amazon, Microsoft, etc. - are part of an ecosystem of teams that work on products, research, and/or operations. A given employee may be working on multiple products or problem statements as part of their typical day-to-day responsibilities within a single team, but also be involved in other work and roles as part of specialized teams through hackathons, employee resource groups, special interest projects, committees, and the like.

This essence of dynamic teamwork is acknowledged but not fully explained by theories of membership change or multiple team membership. Instead, much of the relevant work has been conducted in adjacent literatures that have not been well-connected to the teams literature. In addition to transitions across *people*, other literatures articulate three other types of boundaries crossed in teamwork: (1) literature in human factors psychology has much to offer in understanding how individuals adapt to transitions in their *tasks* (e.g., Allport & Wylie, 2000; Monsell, 2003), (2) research in management and organizational behavior on *role* boundaries and micro-role transitions speaks to how individuals are affected by the daily shifts in expectations of their behavior from one role to another (e.g., Ashforth, Kreiner, & Fugate, 2000; Nippert-Eng, 1996), and (3) findings related to *technology* affordances in the informational technology literature are relevant for understanding how individuals affect and are affected by different technologies (e.g., Leonardi, 2011; Orlikowski & Scott, 2008). Unfortunately, despite the wealth of knowledge that has been compiled in these literatures, boundary transitions have tended to be treated in relatively narrow, singular, and static terms, failing to recognize that collaboration characteristic of today's workspaces often involves dynamic transitions across multiple, rarely orthogonal boundaries. Therefore, our first contribution is integrating these disparate literatures

to articulate - in one place - the four types of boundaries and the various dimensions of boundary transitions that exist in teamwork.

Understanding boundary types and dimensions allows us to better conceptualize the experience of the individual involved in teamwork, so we can articulate how boundary transitions invest individuals' cognitive resources. Notably, individuals' cognitions affect the nature of their experiences when traversing such diverse boundaries, and ultimately these cognitive experiences affect their contributions to teamwork. Though not well integrated within a team context, two complementary literatures can be used to more precisely describe these cognitive experiences: (1) sociological literatures have provided the theories and concepts of creating and transitioning across boundaries (e.g., Lamont, Pendergrass, & Pachucki, 2001; Zerubavel, 1996), and (2) research on task switching and human cognition have studied the cognitive mechanics of boundary transitions (e.g., Allport & Wylie, 2000; Altmann & Trafton, 2002; Monsell, 2003). These literatures provide great insight into the experience of transitioning across boundaries, but at different levels of abstraction and outside a teamwork context. We take a deep-dive into the nature and implications of individuals' cognitive experiences during boundary transitions by integrating concepts from both literatures to conceptualize how individual cognition both affects and is affected by boundary transitions and how this cognitive experience ultimately affects the quality and efficiency of individuals' contributions to teamwork and taskwork. Hence, our second contribution is introducing a common nomenclature that can be used to articulate the individual's cognitive experience when transitioning across various types of boundaries in teamwork.

Ultimately, these two key contributions (which reflect integrations across literatures and nomenclatures) result in a third contribution: a holistic framework of the nature and process of

boundary transitions that impact an individual's contribution to teams. We extend theories and research on multiple team membership (Cummings & Haas, 2012; O'Leary et al., 2011) and fluid team boundaries (Dibble & Gibson, 2018) by generating propositions regarding the effect of boundary transitions on the exertion or expansion of an individual's cognitive capacity as well as the role played by the frequency and practice of boundary transitions in the transition process. Because boundary transitions are an individual-level psychological process, we consider their implications for individuals' cognitive experience (i.e., cognitive exertion and expansion) and elaborate on the role these cognitive outcomes may play in teams through the impact of transitions on individual contributions to teamwork and taskwork. A deeper understanding of the nature and implications of boundary transitions involved in dynamic teamwork illuminates profitable interventions and directions for future research on the nature and implications of dynamic teamwork.

DEFINING BOUNDARIES IN DYNAMIC TEAMWORK

A *boundary transition* constitutes a psychological shift in focus that occurs because of a change in membership, roles, tasks, and/or technologies in the context of teamwork. In a boundary transition, individuals disengage from working within a boundary or set of boundaries to engage within another. Such transitions can occur in the context of a single team or in the context of transitioning across teams. We rely on what is collectively referred to as boundary theory as the backdrop for developing our framework of boundary transitions[1] (Lamont, Pendergrass, & Pachucki, 2001; Zerubavel, 1996).

[1] Consistent with work on role transitions, we focus on "micro transitions" (cf. Ashforth et al., 2000), which involve frequent, recurring shifts among people, tasks, roles, and/or technologies. This is in contrast to "macro transitions", which involve permanent shifts in multiple aspects of the collaborative environment (e.g., getting promoted and thereby working with a new team). A second caveat is that the concept of boundary transitions in this framework is distinct from the notion of spanning geographic, cultural, functional, or other diversity-defining boundaries between people or groups of people (Marrone, 2010). Whereas the "spanning" of such boundaries is certainly a common

Boundary Theory

Although the application of "boundaries" has varied across literatures, they are consistently used to describe the separation of one entity from another whether by "physical, temporal, emotional, cognitive, and/or relational limits" (Ashforth et al., 2000: 474). For example, sociologists view boundaries as the way in which individuals mentally process the world. By creating "islands of meaning", individuals lump together those things that are similar while simultaneously splitting apart those things that are dissimilar (Zerubavel, 1996), to quickly identify expectations of their participation and contributions within each type of boundary. Lumping signals what belongs within a boundary and splitting creates a mental divide to distinguish what does not belong. A common example of this "lumping" and "splitting" are the combinations of people into departments in organizations (e.g., accounting, human resources, customer service). These boundaries may exist in one's mind, but they have very real manifestations (Lamont & Molnar, 2002), which carry important implications for understanding the context of a social activity such as teamwork (Stryker, 1980; Tajfel, 1979; Zerubavel, 1996).

Though lumping and splitting help us establish some meaning to our experiences, this practice can also make it difficult to traverse boundaries when necessary. The mental distance between boundaries is sometimes so great that moving across boundaries can feel like crossing a great chasm or making a "mental quantum leap" (Zerubavel, 1996: 424). This notion is theoretically important because it implies that not all boundary types and transitions are created equal. Rather, their perceived complexity and meaningfulness varies within and across people, tasks, roles, and technologies. In this paper, we draw attention to the boundaries created by dynamic teamwork, and how "lumping" and "splitting" in a dynamic environment affects the

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aspect of teamwork, individuals do not transition *into* the other boundary. Rather, they engage others across boundaries to accomplish a collective goal.

quality and efficiency of transitions across the boundaries essential to teamwork. We also discuss how individual cognition both affects and is affected by boundary transitions and how the associated cognitive expansion versus exhaustion ultimately affects the quality and efficiency of individuals' contributions to teamwork and taskwork.

Boundary Types in Dynamic Teamwork

Research on work in teams points to four common boundaries traversed by individuals engaged in collaborative work: (1) people, (2) role, (3) task, and (4) technology (Arrow, McGrath, & Berdahl, 2000). It is by traversing these four boundaries that individuals accomplish work in teams or across multiple tasks (Marks, Mathieu, & Zaccaro, 2001), often by structuring roles (e.g., Belbin, 1993; Hare, 1994) and working through various technologies (Orlikowski & Scott, 2008). Each boundary type contains structural features that in part characterize the boundary.

People boundaries have long been part of teams research, denoting who is (and who is not) a member of a team. Interdependence in a task is a structural boundary around a group of people, the boundary is further defined by the way in which this set of people interrelates and operates, particularly in fluid environments (Mortensen 2014). The challenge of transitions across people boundaries is that as people transition, they must continuously invoke different relationships, interdependencies, emergent states, and processes.

Role boundaries delineate the scope of expected behaviors within a role, and often come with specific labels characterizing these behaviors and their function to the team (e.g., connector, team builder, organizer, challenger; Mathieu et al., 2016). The skills, knowledge, and behavior expectations for a role defines the persona the individual should embody while filling that role (Ashforth et al., 2000; Burke, 1980; Hogg, Terry, & White, 1995; McCall & Simmons 1978;

Simon, 1992; Stryker, 1980). The challenge of transitions across role boundaries is that different roles can have largely different skills, knowledge, and behavior expectations that can be in competition. For example, a person may be required to switch from a leadership role that is characterized by self-confidence and dominance to a collaborative role that requires active listening and compromise.

Task boundaries delineate the content and scope of task activities and are defined by the objectives as well as the knowledge/skills/abilities (KSAs) needed for the task. Setting the task boundary for the team is in part a collective effort in mission analysis, goal specification, and strategizing (Marks et al., 2001). An individual's mental representation of the task boundary is derived in part through these explicit processes in which members of a team establish a common understanding of their performance context, what needs to be done, and how they will go about doing it. Transitions from task to task challenge individuals to reorient their attention to different task and process norms for getting work done.

Technology boundaries are set by the affordances and applications of various technologies employed in teamwork (Leonardi, 2011). Beyond the material properties of a technology, a technology's affordances refer to the possibilities for actions that the technology allows users to execute and are uniquely applied by each person or team (Gibson, Dunlop, Majchraz, & Chia, 2022; Markus & Silver, 2008; Leonardi, 2011). The boundary around a technology is created by the team's application of its affordances and its norms for use, which can change over time, making it difficult to establish agreed-upon norms for collaborative use (Gibson et al., 2022). Transitions across technology boundaries challenge individuals to shift their mindset from one set of affordances (or lack thereof) offered by a technology to another and perhaps also a different framework for how the technology is applied within a particular team.

In teamwork, interactions with others influence the nature and formation of these boundaries (Lamont & Molnar, 2002), and in dynamic teamwork, the boundaries continue to flex and adapt as individuals fluidly move across people, roles, tasks, and technologies. Each boundary adds clarity to the other boundaries, such that boundaries are not orthogonal; they exist at the intersection of each of these types. For example, there is a natural interconnection between role and people boundaries such that the identity of the role may shift as the relationships change. Role identities are social in nature such that the features of a role identity are in part informed by a given social group (i.e., a leadership identity may vary by one's team members; Stryker, 1980; Sluss & Ashforth, 2007). Therefore, each transition across people boundaries may also require a reconfiguration in how one perceives and enacts a particular role. Changes in technology as well as people (i.e., changes in relationships, norms, processes, available KSAs) will shift how a task boundary is defined on a moment-by-moment basis (Cooke, Salas, Cannon-Bowers, & Stout, 2000). Tools may be enmeshed in collaboration differently across different teams, or applied differently depending on who is involved in collaboration at the moment (Leonardi, 2011; Orlikowski & Scott, 2008) and as such, the creation, variation, and interpretation of technology boundaries flex from team to team, role to role, and task to task.

A MULTIDIMENSIONAL FRAMEWORK OF BOUNDARY TRANSITIONS IN DYNAMIC TEAMWORK

With an understanding of boundary types and their inherent interdependencies in place, we present an organizing framework detailing the different attributes of transitions across these boundaries which can independently and interactively affect their experienced magnitude and implications. We consider four major dimensions likely to affect individuals' cognitive experience across transitions: (1) the context of the transition - within or between teams (Dibble

& Gibson, 2018) , (2) the breadth of the transition - whether the transition involves crossing one or multiple boundary types (Mortensen et al. 2007; O'Leary et al., 2011), (3) the strength of the boundaries being traversed (Ashforth et al., 2000; Dibble & Gibson, 2018), and (4) the boundary's meaning to the individual (Bailey et al., 2012; Lamont & Molnar, 2002). The first two dimensions - context and breadth - are objectively definable features of the transition process, whereas the second two dimensions - strength and meaning - are subjective in nature and capture individuals' perceptions and interpretations of boundary transitions.

Figure 1 presents an overarching conceptual model. The dimensions of boundary transitions separately and together impact individuals' perceptions of the *magnitude* of the transition (Ashforth et al., 2001), which determines the cognitive load the transition places on the individual. We conceptualize transition magnitude as the size of that "mental leap" across boundaries (Zerubavel, 1996). When the divide between boundaries is large, greater psychological adjustment is needed to transition (i.e., the greater the transition magnitude, the more difficult the transition is to make, and thus the more cognitive resources needed to navigate it). Table 1 provides an overview of the boundary dimensions affecting transition magnitude, along with descriptors of levels of each dimension corresponding to low and high levels of transition magnitude.

Figure 1 about here

Table 1 about here

Transition Context

A primary objective determinant of transition magnitude relates to whether the transition occurs within a single set of interdependent people (team) or across the boundaries of different

teams. A *within-team transition* refers to a change in people, roles, tasks, and/or technologies *within a single team*. Teammates cycle in and out, roles turn over, tasks change, and technology use shifts - all within the context of a single team. Conversely, a *between-team transition* refers to a change in people, roles, tasks, and/or technologies *across different teams*. Between-team transitions require individuals to adjust to new team norms and goals, mental models, schemas, affective states, etc. (O'Leary et al., 2011). Additionally, because the relationships and norms of the team can re-define how one operates within a certain role, or engages with a task or technology, between-team transitions often involve greater transition breadth. Thus, the mental leaps associated with between-team transitions loom large. In contrast, individuals whose boundary transition involves the cycling in or out of a teammate (i.e., within-team people transition), the shifting from one role or task to another (i.e., within-team role or task transition), and/or the use of a different technology (i.e., within-team technology transition), maintain their overarching team context. People and relational dynamics play a central role in teamwork, and having these relationships remain largely the same reduces the difficulty of a boundary transition - individuals can rely on largely the same tacit knowledge and relationships to adapt to a new boundary (Burke, Stagl, Salas, Pierce, & Kendall, 2006; Mathieu, Heffner, Goodwin, Salas, Cannon-Bowers, 2000) rather than shift their mindset to entirely new relationships.

Transition Breadth

A second objective determinant of transition magnitude relates to the number of boundaries being traversed simultaneously (*transition breadth*). A *singular transition* is a transition across either a people, role, task, or technology boundary (i.e., a shift from engaging with one set of people to another set of people, from role to role, from task to task, or from technology to technology). For example, on a tightly-staffed product team, a person who has

several roles for the same project would need to transition between roles that involve designing the product (product design), building the prototype (engineering), and conducting user testing (user experience research). In contrast, a *compound transition* refers to a shift across two or more types of boundaries, such that the individual must navigate multiple boundary changes simultaneously. For example, in the case where an individual shifts from leading a project in one team to being a consultant for a different project on another team, they are experiencing a transition in roles, people, and tasks.

The essence of dynamic teamwork suggests compound transitions are commonplace because boundaries are often intertwined (O'Leary et al., 2011) and it may be expected that the psychological difficulties associated with making a mental leap across a single boundary are amplified when leaping across several boundaries at the same time. Using simple additive logic, compound transitions involve multiple mental leaps and thus are more taxing to individuals' cognitive resources as effort must be expended in both cognitively disassociating from the prior boundaries while cognitively reconfiguring to the new boundaries. Prior theoretical works on boundaries focus on transitions across a single boundary, though there is mention of transitions across multiple domains. Ashforth and colleagues (2000) note that role transitions are increasingly difficult when they pull an individual across temporal, physical, and social boundaries. Research on multiple team membership suggests that changes in team context involve broader changes across tasks, roles, routines, technologies, etc. (Bertolotti, Mattarelli, Vignoli, & Macrì, 2015; Margolis, 2020; Mortensen & Haas, 2018), which together make switching between teams more difficult (O'Leary et al., 2011). Empirical research on task switching suggests that fewer changes in operational components across tasks allow for easier, more efficient transitions (Arrington, Almann, & Carr, 2003). Therefore, transitions across an

intersection of boundaries (i.e., compound transitions) may require greater cognitive load and more motivation than transitions across a single boundary.

Boundary Strength

Boundary strength refers to the starkness of the line drawn around a psychological boundary or the sharpness of the mental divide between entities. Boundaries are defined by emphasizing (1) the similarities of factors, features, and characteristics in a cluster, and (2) the distinctiveness of a cluster from others (Haslam et al., 1998). The stronger the mental division between boundaries, the more defined and psychologically distinct the boundaries become (Zerubavel, 1996), and continue to diverge over time (Ashforth et al., 2000). Roles become entrenched in specific contexts and at specific times, and have core behaviors and expectations that are in high contrast to other roles (e.g., leaders on a project have stronger role boundaries than those in supporting roles; Ashforth et al., 2001; Nippert-Eng, 1996). People establish shared mental models with tacit knowledge of how to operate and anticipate one another's actions (e.g., teams that have stable membership have stronger boundaries than teams in which membership is fluid; Dibble & Gibson, 2018; Mathieu et al., 2000; Mortensen, 2014; O'Leary et al., 2011). Tasks become highly defined, discrete, and entrained to iterative processes (e.g., Annual reporting tasks, with specific time frames and requirements, have stronger boundaries than ad hoc tasks; Kozlowski & Ilgen, 2006; Marks et al., 2001; Ancona & Chong, 1996). Technologies carry discrete and specific functions within the team (e.g., Zoom has a highly specified mode for collaboration vs. a Google doc which allows for asynchronous and synchronous text and is video enabled; Leonardi, 2013, 2011).

When considered in isolation, stronger boundaries are more difficult to cross than are weaker ones. The common theme for transitions across each of the boundary types is that there is

a lack of fluidity and permeability associated with strong boundaries (Dibble & Gibson, 2018), which creates a psychological resistance to transition. The separations between people, roles, tasks, and technologies, on their own, place a high cognitive load on the individual when crossing the boundary (Ashforth et al., 2000; Wickens et al., 2015; Zerubavel, 1996).

Boundary Meaning

Boundary meaning refers to the extent to which a psychological boundary holds personal significance for the individual. The lumping and splitting process helps individuals make sense of reality (Zerubavel, 1996) and the outcomes of this process can look different both within and across individuals at different points in time or under different contexts. Boundaries in dynamic teamwork are not only imposed on the individual by the nature, structure, and context of teamwork, they are also subjectively defined and reinforced (Lamont & Molnar, 2002; Lamont et al., 2001).

People boundaries have meaning to the extent individuals feel a personal attachment to others, perhaps through collective identity (i.e., identification; Ashforth, Harrison, & Corley, 2008; Ashmore, Deaux, & McLaughlin-Volpe, 2004; Tajfel, 1979), cohesion (Zaccaro, 1991; Zaccaro & Lowe, 1988; Zaccaro & McCoy, 1988), or a sense of belongingness (Baumeister & Leary, 1995). Roles also have deep relevance and importance to a person's self-concept (Hogg et al., 1995; McCall & Simmons, 1978; Stryker, 1968). Task cohesion (Zaccaro, 1991; Zaccaro & Lowe, 1988; Zaccaro & McCoy, 1988), intrinsic interest (Deci & Ryan, 1985; Shin & Grant, 2019), and/or the difficulty and perceived importance/urgency (Wickens et al., 2015) of a task draws an individual's attention deeper, such that they may "lose themselves" in the task (Csikszentmihalyi, 1975). Technologies can become enmeshed with the team's process as individuals hold personal preferences or experiences with the affordances of the technology

(Bailey et al., 2012; Orlikowski & Scott, 2008). An example of a meaningful boundary comes from Bailey and colleagues (2012) - Observations of automotive engineers over three years, revealed that while simulation technology allowed virtual modeling and analysis of vehicle performance, physical parts still played a key role in understanding vehicle performance. As such, "design engineers often distrusted the models until they saw the same results in physical tests" (Bailey et al., 2012: 1496).

Overall, the mental leap out of a meaningful boundary involves climbing out from a mental depth where one has become psychologically and/or emotionally embedded ultimately making transitions from meaningful boundaries less efficient and more difficult compared to transitions from less meaningful boundaries (Ashforth et al., 2000; Wickens et al., 2015; Zerubavel, 1996).

Combined Effects of Boundary Transition Dimensions

When considered in isolation, each dimension logically increases a transition's magnitude, but the story becomes more complicated when these dimensions are considered in combination. One possibility is that these boundary transition dimensions are not equivalently impactful in determining transition magnitude. For example, in general, it would seem that of the four dimensions, boundary meaning would be the most influential factor determining transition magnitude, because this dimension is tied to an individual's self-concept and/or their preferences, embeddedness, and enthusiasm for work. Meaning makes a boundary very personal and uniquely important, and motivates a person to act in ways that are consistent with who they are and what they value (Balliet, Wu, & De Dreu, 2014; Shin & Grant 2019; van Knippenberg, 2000). Therefore, although additive logic may suggest that a compound transition is more difficult than a singular transition, it may well be the case that a singular transition across a very

meaningful boundary is higher in magnitude than is a compound transition across less meaningful boundaries.

Another possible complication is that these dimensions interact in a way that increases/decreases their relative effects. For example, the task switching literature provides evidence to demonstrate that a transition between strongly bounded tasks is more difficult than that of tasks with weaker boundaries (Arrington, Altman, & Carr, 2003), but this research would also suggest that when two similar tasks overlap temporally the similarities across tasks may interfere with their execution, particularly when other elements of the boundary are disparate (Pashler, 1998). In the context of teamwork, multiple tasks done within the same team context may be more difficult since the same members are involved in both tasks making discussion and simultaneous execution of similar tasks more likely and task processes more blurred. In contrast, a transition between similar tasks may be easier when the team context also changes as there is less likelihood that the similar tasks of two different teams are happening at once. Though there is also a possibility that when the same task or technology is to be executed across different team contexts, elements of task execution within one team context will interfere with task performance or technology execution in the other team context particularly if one context is more meaningful or defined/stronger than is the other.

The differential and interactive effects of various combinations of these dimensions are likely to affect perceived transition magnitude in ways other than a simple additive process would suggest. This framework demonstrates that in the context of dynamic teamwork broadly, the siloed literatures on boundaries and the different boundary types do not capture the full picture. From these literatures we find evidence of how each boundary dimension may

independently influence perceived transition magnitude, but by considering them together, we can begin to investigate their more complex interactive effects.

Proposition 1a: Boundary context, breadth, strength, and meaning separately and together determine the magnitude of a boundary transition.

Comparing the Ongoing vs. Alternative Boundary

Relative assessments of the ongoing boundary (where a potential transition originates) and the alternative boundary (where a potential transition will end) also affect transition magnitude. Both boundaries are subjectively defined by their strength and meaning, but they are also objectively defined by whether the transition is within or across teams (context). Taken together, there is a motivational aspect of boundary transitions that originates in how an ongoing boundary compares to an alternative boundary. Work in human factors psychology proposed the motivational aspect of boundary transitions can be conceptualized by (1) the "stickiness" of the ongoing boundary, and (2) the "attractiveness" of the alternative boundary (or set of boundaries; Wickens et al., 2015; 2016). Ongoing boundaries are "sticky" when they are strong and meaningful, making them more difficult and less appealing to move away from (Wickens et al., 2015). For example, creating a quarterly presentation for leadership on a high impact topic area will be sticky/difficult to pull away from when an individual is working with teammates they are attached to and the topic is something the person is passionate about. Attractiveness of the alternative boundary is affected by both its perceived strength and meaning but also by whether it will involve a change in team context. Changes in team context require additional cognitive resource expenditure since disengaging and reengaging across team boundaries typically implies a compound transition; compound transitions bring added complexity as they involve the simultaneous crossing of multiple boundaries, each with their own set of characteristics affecting

their perceived "stickiness" versus "attractiveness". For example, transitioning away from working with one's teammates on the presentation to working with a conflict-ridden cross-functional group is much less attractive than transitioning to a brainstorming task with one's teammates.

Logically, transition magnitude will be at its lowest when the ongoing boundary is not at all sticky and the alternative boundary is quite attractive. However, given a general aversiveness to change, even these sorts of low-cost transitions place a burden on the individual's finite pool of cognitive resources (Kool et al., 2011; Kurzban et al., 2014). Perceived transition magnitude and aversiveness to change will be attenuated by the inherent intrinsic motivation derived from the desire to engage in an attractive alternative boundary (Wickens et al., 2015). Not surprisingly, when the inverse is true - the ongoing boundary is very sticky and the alternative boundary is unattractive - transition magnitude will be at its highest. In the event both the ongoing and alternative boundaries are sticky/attractive, transition magnitude will still likely be high given the psychological effort required to disengage with an ongoing boundary to re-engage elsewhere. Finally, when ongoing and alternative boundaries are neither sticky nor attractive, transition magnitude will be moderate with a baseline aversiveness to change disincentivizing movement across boundaries.

Proposition 1b: Comparisons between ongoing boundary stickiness and alternative boundary attractiveness affect transition magnitude.

COGNITIVE CONSEQUENCES OF BOUNDARY TRANSITIONS

Given the inherent interplay between individual cognition and boundary transitions, theories of human cognition (e.g., Engle, 2002; Kanfer & Ackerman, 1989; Logan, 2003; Monsell, 2003) are needed for understanding what these mental leaps/crossings entail and their

potential consequences. Our integration of these two lines of thought provides a more holistic perspective of boundary transitions, and additionally, illuminates the mechanisms through which individual cognition is affected by boundary transitions.

As individuals navigate boundary transitions, boundary meaning and strength as well as transition context and breadth interact to determine perceived transition magnitude and thus the demand placed on the individual's cognitive resources. The consumption and creation of cognitive resources resulting from navigating boundaries of various magnitude result in two potential cognitive consequences which ultimately have implications for the quality of individuals' contributions to teamwork/taskwork: (1) *cognitive exertion* and (2) *cognitive expansion*.

Cognitive Exertion

Cognitive exertion refers to mental effort expended in a boundary transition. When an individual is engaged within a particular boundary, transitioning across boundaries constitutes a cognitive disruption (Jett & George, 2003; Logan, 2003; Rubenstein et al., 2001). Individuals must mentally disengage from a boundary (or boundaries) to re-engage elsewhere. For example, a person that is deeply engaged in an analytical task must put effort toward reorienting their attention when their calendar reminder prompts them to join a meeting with another project team. Cognitive attentional resources are finite, however, and can be depleted when inefficiently allocated and/or when allocated for a difficult problem (Borst et al., 2010; Rubenstein et al., 2001; Kanfer & Ackerman, 1989). As transition magnitude increases, so too does the demand for cognitive resources to navigate the transition (Brehm & Self, 1989; Demanet, Liefooghe, & Verbruggen, 2011). Being able to meet the demands for cognitive attentional and motivational effort is critical to an individual's ultimate performance within the new boundary (Brehm & Self,

1989; Demanet et al., 2011; Kahneman, 1973). Thus, transitions are characterized by their cognitively disruptive nature.

Researchers in the task-switching literature liken the transition process to gears shifting in a person's mind (Monsell, 2003), and argue that this mental gear-shift is not always smoothly executed. In the process of making a transition, individuals may experience a "switch cost" when transitioning to the new boundary (e.g., ineffective completing the ongoing task and/or a slowed start-up time in the alternative task; Allport & Wylie, 2000; Altmann & Trafton, 2002; Jarmasz, Herdman, & Johannsdottir, 2005; Monsell, 2003). What is "costing" the individual during the switch, is in part the mental gear shifting. More specifically, individuals are going through the cognitive process of reconfiguring their attention onto stimuli within the new boundary. This reconfiguration involves retrieval of "new goal states (what to do) and condition–action rules (how to do it) into procedural working memory (or deleting them)" (Monsell, 2003: 135). Cognitively, this requires individuals to switch from navigating/processing aspects associated with the ongoing boundary (e.g., its objectives, processes, requirements, expectations, norms, affordances, etc.) to engage in and begin navigating/processing the aspects associated with the new boundary. Transitions with the highest switch costs are (1) those that require the largest mental gear shift, and/or (2) those in which individuals must apply greater mental effort to engage within the new boundary.

Others have found evidence that the processes associated with a boundary can inhibit progress in a new boundary, meaning that the transitions have lasting effects on subsequent actions/performance (Mayr & Keele, 2000; Wylie & Allport, 2000). Similarly, in the role literature, researchers have found that behaviors associated with one role can interfere with performance in a different role (e.g., spillover theory; Byron, 2005). These findings suggest that

switch costs will persist even when an individual is aware the transition is imminent or they have experienced the same transition previously (Newton et al., 2020). All boundary transitions require a reconfiguration of mental processes and the reallocation/exertion of limited cognitive attentional resources, though high magnitude transitions deplete cognitive resources faster and to a greater extent than do low magnitude transitions.

Proposition 2: Increased transition magnitude results in greater cognitive exertion.

Cognitive Expansion

Importantly, the exertion of cognitive resources does not always result in resource depletion. *Cognitive expansion* refers to mental capacity that is extended/enhanced through a boundary transition. Since boundary transitions provide opportunities for strategic thinking, individuals can use these disruptions to connect and develop ideas (Jett & George, 2003), garner instrumental resources across boundaries, and/or the social support relationships that empower individuals to proactively engage within the new boundary (Ancona & Caldwell, 1992; Burt, 2005; Chen et al., 2019; Oh, Labianca, & Chung, 2006) and ultimately facilitate transition efficiency. For example, a software developer who is working on two different projects may recognize a product feature from one project that is relevant to the other, and further may work with teammates to develop guidance for how to develop the feature in a variety of products across the company.

Moreover, being prompted to transition across boundaries can diminish the chances individuals become cognitively fixed or entrained in one boundary and thus even less efficient in transitioning to another boundary. This notion is seen in research demonstrating that taking mental breaks can promote creativity through enhancements to convergent and divergent thinking (Lu et al., 2017). Boundaries that are separated by great psychological distance may be

more difficult to traverse yet may offer distinct experiences and perspectives to aid in work across other boundaries (O'Leary et al., 2001).

Theories of resource allocation and conservation support the notion that, in some instances, the allocation of resources ultimately begets cognitive renewal through a gain spiral process wherein the initial allocation of resources promotes enhancements in knowledge, creativity, individual behavior/process, etc., which serve to refuel and expand the individual's cognitive resources (Bakker & Demerouti, 2007; Salanova, Bakker, & Llorens, 2006; Salanova, Schaufeli, Xanthopoulou, & Bakker, 2010). From a learning theory perspective, individuals who engage in multiple tasks, work in different roles, and interface with different people using multiple technologies, have different contexts within which they can experiment as well as gather and apply new knowledge, skills, and perspectives (Kolb & Kolb, 2012; O'Leary et al., 2001). Indeed, traversing across boundaries can both broaden and deepen knowledge and understanding of the nuances of a problem (Kolb, 1984), ultimately enhancing resources (Marks, 1977; Ruderman, Ohlott, Panzer, & King, 2002) that can then be re-allocated during subsequent boundary transitions (Lu et al., 2017; Wylie & Allport, 2000).

We see evidence of the idea of cognitive resource expansion in the task-switching literature. Research has demonstrated that the diversity in boundaries one traverses creates novelty which enhances cognitive function and facilitates learning (Sabah, Dolk, Meiran, & Dreisbach, 2018). Learning accumulated through boundary transitions *expands* cognitive capacity (builds cognitive resources) such that more resources are available to be re-allocated in subsequent work (Lu et al., 2017). In essence, transitions across people, roles, tasks, and/or technologies may lead individuals to become more creative and strategic such that they become more adept at (as outlined in Perry-Smith, 2006) making remote associations (i.e., seeing

connections between different concepts; Mednick, 1962). The learning, associations, or resources gained across boundaries make the best use of one's attentional resources and ease the cognitive burden of making transitions over time. This facilitates not just one transition, or even one type of transition, but changes the way an individual thinks about their work within and across people, tasks, roles, and technologies. In sum, transitions higher in magnitude offer more opportunities for cognitive expansion.

Proposition 3: Increased transition magnitude results in greater cognitive expansion.

Linked Cognitive Consequences

Cognitive exertion and cognitive expansion are inextricably linked. An individual engages in boundary transitions that exert at least some level of their cognitive resources, but the allocation of these resources may, when effectively employed, yield opportunities for resource renewal and expansion. Not only might the investment of cognitive attentional resources restore and rebuild cognitive resource pools, it may promote the renewal of psychological resources drained by stress or fatigue associated with boundary transitions, ultimately benefiting motivational resources. While an individual is exerting their cognitive capacity to engage in a transition, they are simultaneously learning information that can ease future boundary transitions and expand their knowledge for utilizing their cognitive resources. Frequent transitions, though cognitively taxing, prevent "cognitive fixation" on inefficient or outdated processes, such that individuals are better able to see new and creative ways of working across boundaries (Lu et al., 2017; Storm & Angello, 2010). Thus, the process of cognitive exertion is a part of cognitive expansion (Marks, 1977).

In an argument for the expansion of human energy (vs. depletion) through participation in multiple roles, Marks (1977) argues that this idea is not just conceptual, but physiological.

Humans chemically produce energy from molecules (i.e., ATP), but this production is stimulated by the consumption of the same molecules. More recently, research on gain spirals (Bakker & Demerouti, 2007; Salanova et al., 2010; Salanova et al., 2006) has raised the notion that when individuals effectively allocate their finite resources, they may recoup and/or build those resource pools via, for example, the collaborative efforts with others (e.g., innovative or creative enhancements that make their work more efficient/effective) and/or their success and enhanced experience with a task, role, and/or technology (e.g., knowledge/skill acquisition). Taken together, research suggests the consequences of resource allocation associated with cognitive exertion and expansion are interrelated such that resource allocation may initially yield cognitive exertion, but enhancements to creativity and learning as well as to social and motivational benefits ultimately result in the expansion of cognitive resources.

Proposition 4: Cognitive exertion and cognitive expansion are inextricably linked such that the effective allocation/exertion of resources may result in cognitive expansion over time.

TEAMWORK CONSEQUENCES OF BOUNDARY TRANSITIONS

The effects of boundary transitions on individual cognitive processes ultimately manifest in the quality of an individual's social behavior, particularly in the context of teamwork and taskwork. An effective teammate should be able to meet the expectations of their role as a contributing member of the team, adapt to the team's needs, and proactively influence the team's strategy and situation (Carpini, Parker, & Griffin, 2017; Griffin, Neal, & Parker, 2007). The capacity to contribute effectively in these ways is either hindered or enhanced by the exertion or expansion resulting from boundary transitions. The focus on what happens to individuals in the process of transitions ultimately becomes a central issue for the team as these individual

contributions to teamwork and taskwork are ground zero for the emergence of effective (or ineffective) team process and climate (Kozlowski & Klein, 2000).

As previously discussed, high magnitude transitions may result in a slowed start-up time when initially engaging within the new boundary (Allport & Wylie, 2000). The exertion of cognitive energy to engage in new boundaries may influence individual contributions to the team (e.g., the person may initially be slow to think or react while changing mental gears which limits their capacity to engage in core taskwork and teamwork activities within the new boundaries). A person's ineffective contributions to the team can ultimately slow progress team-wide (Diehl & Stroebe, 1987; Lamm & Trommsdorff, 1973). Particularly in a work context where time together is limited and the expectation is to make the most out of the minimal amount of time (Kirkpatrick, 2006; Mroz, Allen, Verhoeven, & Shuffler, 2018), the impact of an individual's exertion on their ability to coordinate can become quite problematic.

In addition, high magnitude transitions may require a person to pull away from boundaries in which they are deeply entrenched - perhaps because these boundaries are intrinsically meaningful or strongly defined. The engagement with prior boundaries can have a lingering effect on engagement within the new boundaries (Newton et al., 2020) as individuals expend cognitive energy to let go of the prior boundaries and allocate persistence and intensity toward work within new boundaries (Byron, 2005). Slowed and lackluster contributions to teamwork and taskwork from an individual will have downstream consequences for the team if members who perceive a lack of motivation in their teammates may accordingly guard themselves against free-riders and reduce their own contributions (Shepperd, 1993) and/or simply regard the work as less meaningful.

Proposition 5: Cognitive exertion attenuates individual contributions to teamwork and taskwork.

In contrast to cognitive exertion, cognitive expansion may promote individual contributions to taskwork and teamwork. For one, personal cognitive expansion can support individual creativity. Individuals may provide new ideas and perspectives they have gained or contribute to the novel integration of ideas given their own broad perspectives. A second contribution to the team may be better quality information or stronger skills. As high magnitude transitions provide the proving ground for knowledge and skills, individuals who can take advantage of boundary transitions to experiment and learn may acquire nuanced understanding of problems (Kolb, 1984) that can ultimately contribute to the team's knowledge and aid in better strategic thinking. Cognitive expansion is therefore a route through which individuals might improve their performance as a team member (e.g., by contributing to better strategy or to innovations that ultimately assist the team in improving performance and avoiding failure). As such, there is both personal and social incentive to translate personal cognitive expansion into contributions that might eventually promote team-wide synergies.

Proposition 6: Cognitive expansion enhances individual contributions to teamwork and taskwork.

MODERATING INFLUENCES IN BOUNDARY TRANSITIONS

The relationships described within our process model of boundary transitions may be impacted to some extent by how often one engages in boundary transitions (transition frequency) and the automaticity of processes within each boundary (transition scripts). Although frequent boundary transitions place greater cognitive load on individuals, over time, well-paced recursive

transitions can result in the development of schemas or scripts that permit automatic behaviors/processes across boundaries and aid in reducing transition magnitude.

Transition Frequency

In practice, the need for boundary transitions may arise with varying frequency. A person may have a long stretch of time between transitions, or conversely may engage in boundary transitions in rapid succession. For example, the analyst deeply entrenched in their work that is prompted to enter a meeting might have meetings with different teams scheduled back-to-back throughout the day, prompting them to continuously engage in transitions in rapid succession. The latter situation may feel like multitasking (i.e., simultaneously engaging in more than one boundary at a time). However, despite the common belief that individuals can "multitask" (Borst, Taatgen, & vin Rijn, 2010), what may be perceived as multitasking is a quick series of boundary transitions (Schumacher et al., 1999). The effects of transition magnitude on cognitive exertion are exacerbated by rapid recursiveness across boundaries. Unfortunately, people are only able to cognitively attend to one stimulus at a time because the human brain is wired such that it cannot select more than one response at any given moment (Logan, 2003). As such, under circumstances in which an individual is attempting to engage/"multitask" in more than one boundary at a time, they are actually attending to each boundary in a hierarchical fashion and managing the dynamics of the ongoing/alternative boundaries in rapid succession (Logan, 2003; Schumacher et al., 1999). This takes an already complex process and adds an element that further intensifies its difficulty. Highly frequent boundary transitions create a "response selection bottleneck" (Schumacher et al., 1999) and cognitive overlap across boundaries (Borst et al., 2010) that, if paired with high magnitude transitions, result in even greater cognitive exertion that ultimately results in extended response times, increased errors, distractibility, forgetting, and

anxiety (Lu et al., 2017). Alternatively, when there is more time in between boundary transitions, a person has time to adjust within a new boundary before having to make another switch. Similar difficulties with changing mental gears apply, particularly if a transition is compound, but there will be time to engage within the new boundary and recover some cognitive resources before moving on again.

Proposition 7: The frequency of boundary transitions moderates the relationship between transition magnitude and cognitive exertion, such that the relationship is more strongly positive when the frequency of boundary transitions is higher, rather than lower.

Transition Scripts

The nature of boundary transitions in teamwork are such that a person will often encounter the same transition not once, but multiple times over the course of collaboration. Recurrent boundary transitions will, over time, generate an automatic process - a transition script or mental model are cognitive structures that detail the typical or appropriate behaviors for a given process (Ashforth et al., 2000; Fiske & Taylor, 1991; Gioia & Poole, 1984) and that enable a person to (1) engage in the sorts of actions that will help them pick up where they left off when they re-engage a boundary, and (2) allocate fewer attentional resources when transitioning to a new boundary. For example, the analyst with a busy meeting schedule may schedule recurring meetings at the same time each week so the work becomes habitual with a certain time & day, or they may keep the same meeting structure each time to entrench a familiar process.

Transition scripts can serve to reduce the perceived magnitude of transitions by reducing the cognitive load imposed by the various dimensions of a boundary transition (i.e., strength, meaning, breadth, context). A learned script for a transition is an acquired tool that frees up some of the attentional capacity once devoted to making a transition (Kanfer & Ackerman, 1989). As

the boundary transition becomes practiced, fewer attentional resources are required, such that it becomes more resource-insensitive (i.e., a resource-dependent transition becomes resource-insensitive as the individual develops the skills to navigate the transition more easily). Transition scripts can provide cues for an upcoming transition and an order of operations for how to transition giving the transitions predictability and familiarity (Ashforth et al., 2000). Transition scripts do not eliminate the mental costs associated with making boundary transitions, but the mindless nature of well-practiced boundary transitions, even if compounded by multiple boundaries to be crossed, make them seem more manageable (i.e., lower perceived magnitude). Alternatively, when a boundary transition is newly triggered, a slow process of reconfiguring attention may ensue - "putting down" the behaviors, expectations, and elements associated with one boundary and "picking up" those associated with the new boundary (Monsell, 2003; Wylie & Allport, 2001) - which because of the lack of practice makes the cognitive leap across boundaries feel bigger.

Proposition 8: Transition scripts moderate the relationships between boundary dimensions and transition magnitude, such that the relationships are more strongly positive when boundary transitions are new and become attenuated over time as transition scripts develop.

DISCUSSION

Individuals working within teams today may be experiencing an abundance of boundary transitions (across people, tasks, roles, and technologies); the nature and interaction of these transitions has implications for their contributions to teamwork and taskwork. The explicit focus on boundary transitions provided herein enables new theorizing about teams and the development of practical ways to promote individual and team effectiveness. Boundary

transitions have a meaningful psychological and cognitive impact on the individuals that traverse them (Zerubavel, 1996), and the efficiency with which they traverse boundaries ultimately affects their contributions to teamwork and taskwork.

Theoretical Implications

We make three key theoretical contributions. First, we integrate siloed literatures related to types boundaries and dimensions of boundary transitions. Our model of boundary transitions in dynamic teamwork and its associated propositions leverages research across several disciplines (human factors, cognitive psychology, organizational behavior/psychology, sociology, human physiology, etc.) to advance a multidimensional framework of boundary transitions. Bringing together existing research on boundary transitions from these previously siloed sources advances a fuller scope and new perspective on boundary transitions - deeper exploration into a transition's magnitude is not possible without this integration of literatures that provides insight into how context and breadth of a transition as well as strength and meaning of boundaries independently and interactively impact perceived transition magnitude. Our consideration of boundary transition dimensions together may even contradict what is expected when the dimensions are taken in isolation. Additionally, considering boundary transitions through the stickiness/attractiveness lens introduces the intrinsic motivational aspect of boundary transition effectiveness. The full scope of transition dimensions and the idea that transition dimensions hold a motivational component regardless of the type or complexity of the boundary crossed gives new perspective to research on team boundaries (e.g., Dibble & Gibson, 2018; Mortensen, 2014) which has provided foundational insights on the fluid nature of teams, but has tended to focus only on people boundaries which limits the scope of dimensions considered.

Theorizing in these arenas may benefit from a more comprehensive set of ideas around how people move across multiple types of boundaries when collaborating.

Second, we integrate nomenclature from these literatures to help us better conceptualize and articulate the experience of boundary transitions at the individual level. Our inclusion of the literature on cognition and task switching has several theoretical advantages. First, it brings precision to the concept of cognitive exertion and the process of engaging in high magnitude boundary transitions. Second, this literature provides a new understanding of sociological theorizing on boundaries (Lamont & Molnar, 2002; Lamont et al., 2001; Zerubavel, 1996) through the integration of concepts such as "mental leaps" and "islands of meaning" with concepts that are manifested in human cognition such as "switch costs." The implication for the sociological literature is a more precise understanding of the potential advantages and disadvantages of engaging in boundary transitions, which is essential to understand the full range of impact of boundary transitions. Third, this integration provides an extension of theorizing on task-switching (e.g., Allport & Wylie, 2000; Newton et al., 2020; Wickens et al., 2015), by addressing how task boundaries are shaped and flexed by social aspects of work environments. For example, future models on the factors influencing a task-switch may benefit from consideration of how the teamwork context influences the choice to make a task-switch.

Third, we generate a multidimensional framework of boundary transitions that explains how boundary transitions affect the quality of individuals' contribution to *teamwork and taskwork*. This framework optimistically considers that individuals can expand their cognitive capacity through their entanglement in dynamic teamwork and considers how the frequency of transitions and the generation of transition scripts influences the experience of boundary transitions in teams. Situating the cognition literature within the fluid teamwork context grounds

theories of cognition in a team context which allows us to theorize how one might reduce exertion to benefit teams and further grounding this framework in the context of teams. This contributes to the literature on multiple team membership (MTM, O'Leary et al., 2001) which has discussed the positive and negative consequences of team transitions, but has not fully elaborated on how the experience of crossing boundaries, and doing so recursively, translates to contributions in teams.

Limitations and Directions for Future Research

Our framework of boundary transitions in dynamic, collaborative work is not only informative to theory on teams, but also contributes to existing theories related to roles, norms, task switching, team process, individual and team cognition, technology affordances, etc. in that we illustrate the inherent interrelatedness of these constructs as well as their dynamic (rather than static) nature. We suggest several profitable directions for future research to further elaborate our understanding of boundary transitions in dynamic teamwork.

Ecological validity of cognition research to teamwork. Although a strength of our model is the incorporation of cognition research to a teamwork context, this may also present a limitation. Although the nature of cognitive exertion/expansion is the same regardless of the context in which it is occurring, most cognition research has been conducted in isolated and highly prescribed lab settings, so it is unclear the extent to which these findings are directly attributable to a field context. Research is needed to confirm the generalizability of these findings to teamwork in a work context.

Team design and interconnectivity. Teamwork designs and interconnectivity may affect boundary transitions. For example, future research may consider how the virtuality of the team influences the perceived magnitude of a boundary transition, and individual team-member

behaviors after a transition. Virtual team members may struggle to communicate and form bonds, which may influence the strength and meaning of their boundaries (O'Leary & Mortensen, 2010).

Additionally, insufficient research exists to allow speculation as to how the interconnectivity of teams and nature of boundaries may contribute to perceived transition magnitude across individuals and its associated outcomes across levels of analysis, though scholars have begun to explore these questions. In MTM contexts, process loss in one team likely means process loss across multiple teams. As Mortensen and colleagues (2007: 6) note, "slippage in one project can create a domino effect, as the work on other projects needs to shift to accommodate unanticipated difficulties or delays." The reduced amount of attention individuals can devote to any one team can increase the length of time it takes the team to complete a project (Anavi-Isakow & Golany, 2003). For example, Engwall & Jerbrant (2003: 407) recounts the story of one manager who stated, ''We have 20–30 ongoing projects at the same time, then one project is delayed, and all our planning is disturbed. And this doesn't affect only this single project, instead everything slips away and ends up on top of each other.'' Taken together, research suggests that the individual costs of boundary transitions scale up to the team level (e.g., Bertolotti et al., 2013; Chan, 2014; Pluut, Flestea, & Curşeu, 2014). Research might explore how a team's ability to reflect and adapt can intervene to reverse and avoid process loss (Schippers, West, & Dawson, 2015; Widmer, Schippers, & West, 2009).

The benefits of boundary transitions can also scale up to impact the team ecosystem, and as research has suggested that fluid collaborations can be advantageous and are increasingly common (Edmondson, 2012), there is an opportunity to explore how boundary transitions contribute to the well-functioning of an ecosystem of teams. Additionally, teammates' boundary

transitions and associated consequences can subsequently impact boundary transitions at the individual level (i.e., a top-down influence of collective boundary transitions). Future research is needed to explore the multi-consequence, multilevel effects of boundary transitions.

The role of boundary transitions in team-level emergent states, processes, and outcomes. We have narrowed our discussion of boundary transitions to causes and consequences at the individual level, but moving forward, a more holistic approach should include team-level constructs. For example, team-level emergent states have a downward influence on individual cognition and behavior, and thus future research is needed to articulate their influences. How do team-level states such as cohesion, identification, and motivation affect boundary transition magnitude? We speculate on the role of boundary types and transitions as well as cognitive influences on individuals' cognitive expansion/exertion as well as individuals' contributions to teamwork, however, we were unable to incorporate such team-level constructs in the current model. This is a prime direction for future research.

Technological affordances. A profitable direction for future research would be to explore how technologies may be used to support the efficiency and quality of boundary transitions in dynamic teamwork; some of this work has already begun (Gibson et al., 2022; Gupta & Woolley, 2018). Technology is intricately interwoven with teamwork in today's workplaces (Gibson et al., 2022; Ng, Leonardi, & Contractor, 2017; Orlikowski & Scott, 2008). Although technology in and of itself represents a boundary to be traversed, perhaps technology may also hold a key to minimizing the challenge of other boundary transitions. Affordances provided by various collaborative technologies (e.g., information retention & accessibility, simultaneous editability) may be harnessed to facilitate work within and across boundaries. Much research has explored how various technologies can benefit team collaboration by

developing and maintaining shared cognition, facilitating communication, connecting geographically separated members, etc. (Carroll, Neale, Isenhour, Rosson, & McCrickard, 2003; Leonardi, 2013). Consistent use of these technologies across organizations or industries may minimize the cognitive exertion and maximize cognitive expansion associated with boundary transitions (DeSanctis & Poole, 1994).

Practical Implications

Dynamic teamwork can increase autonomy, excitement, and engagement in work by allowing individuals to be involved across different projects according to their skills and preferences (Truxillo, Cadiz, Rineer, Zaniboni, & Fraccaroli, 2012). This enrichment in jobs can in turn improve team and organizational effectiveness (Gagne & Deci, 2005). Practically, this requires leaders (1) to clearly communicate and gain employee buy-in regarding priorities, goals, objectives, and resources/constraints central to unit effectiveness (Newman, Ford, & Marshall, 2020), and (2) trust employees to structure their work appropriately and to support them as needed (Brower, Lester, & Korsgaard, 2017). Enriching and engaging work, while at times mentally taxing and tiring, is also exceptionally motivating to employees, particularly when they receive necessary support from supervisors and teammates (Umstot, Bell, & Mitchell, 1976) and are empowered to leverage their strengths and competencies when navigating transitions (Zimmerman, 1995).

While promoting job enrichment through effective boundary transitions, organizational leaders must also identify ways to minimize the potential for and implications of cognitive exertion. The application of technology and infrastructure offer practical solutions. For one, leaders ensure the continuity of technology, systems, and processes across the organization or within an industry to reduce the degrees of differences across boundaries (Adler et al., 1996;

Zika-Viktorsson, Sundström, & Engwall, 2006). Second, leaders can apply tools that assist workers in managing and monitoring multiple unrelated projects to promote more seamless transitions across projects and teams (Anavi-Isakow & Golany, 2003; Cohen, Golany, & Shtub, 2007; De Maio, Verganti, & Corso, 1994; Engwall & Jerbrant, 2003; Payne, 1995). Third, new tools are warranted. For example, a tool that marries the capabilities of a multi-project management system (Cohen et al., 2007) with that of a recommender system that uses socio-psychological information to form teams (e.g., Salehi, McCab, Valentine, & Bernstein, 2017) may be able to assist with the allocation of resources across multiple projects as well as assemble and track teams with an eye towards the teamwork aspects that lead to effectiveness.

Conclusion

Dynamic teamwork has the potential to maximize organizational innovation and viability. However, leveraging teams to reach this potential requires a deeper understanding of the opportunities and constraints faced by individuals working in these dynamic environments. Effectively implementing dynamic teamwork requires a holistic perspective of the nature and network of boundaries traversed by the individuals that make up these teams. Organizations must strategically design the ecosystem of teams by considering the interconnectedness of people, roles, tasks, and technologies, as well as recognizing the objective and subjectively experienced nature of these boundaries which predict and affect the quality of work performed within and across these boundaries. In this way, understanding the nature and implications of an individual's boundary transitions has the potential to result in significant enhancements to success at individual, team, and ultimately organizational levels.

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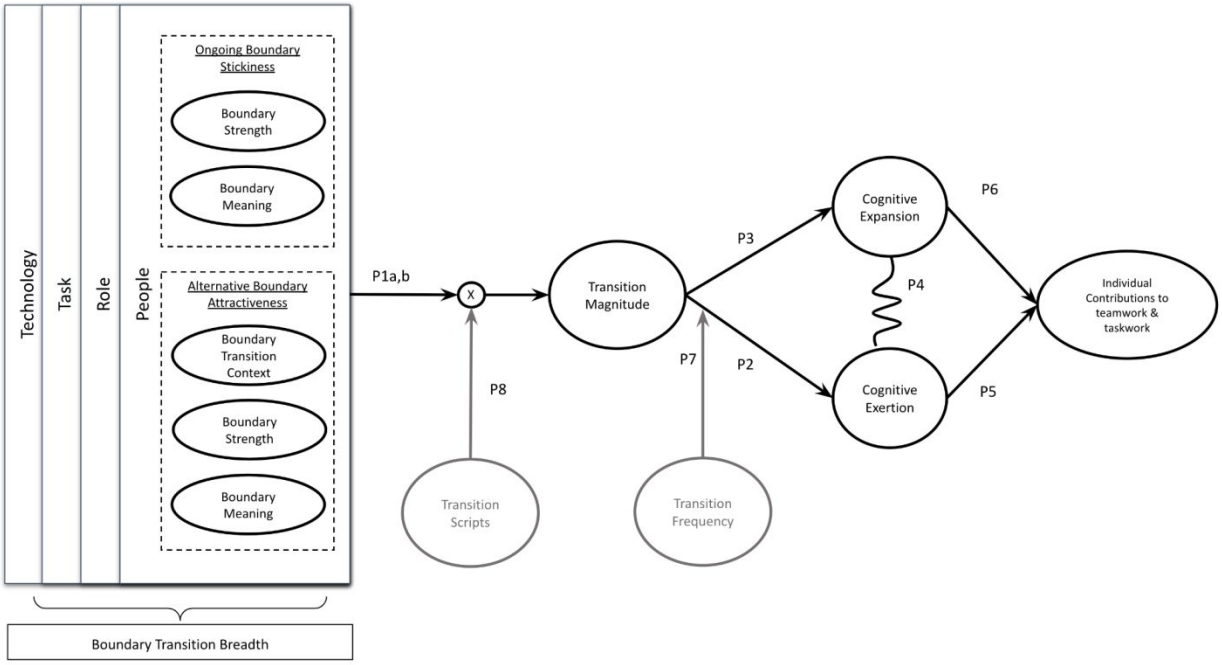
TABLE 1
Determinants of Transition Magnitude

Factor	Description	Transition Magnitude: Low	Transition Magnitude: High
Independent Dimensions			
Objective Features of the Boundary Transition			
Boundary Transition Context	Whether or not the transition involves a change in teams	Transitions *within a team* involving changes in people, roles, tasks, and/or technologies	Transitions to *a different team* involving changes in people, roles, tasks, and/or technologies
Boundary Transition Breadth	Number of boundaries being crossed during a transition	*Singular transitions* involve crossing one people, role, task, or technology boundary	*Compound transitions* involve crossing two or more boundaries
Subjective Factors that Form Psychological Boundaries			
Boundary Strength	Degree of psychological division between boundaries, as determined by similarities versus contrasts in constituent elements	*Weak boundaries* have similar features that are relatively non-distinct from one another	*Strong boundaries* have dissimilar features that are highly distinct from one another
Boundary Meaning	Extent to which a boundary has personal significance to the individual	Transition across boundary involving weak personal attachment, and low degree of self-definition	Transition across boundary involving strong personal attachment, and high degree of self-definition
Complicating Factors			
Combined Dimension Effects	Degree to which combinations of boundary factors strengthen or lessen magnitude	Boundary factors *mitigate/offset* one another; e.g., transition across a strong but not meaningful boundary or transition across a weak	Boundary factors *reinforce/augment* one another; e.g., compound transition across a strong boundary

		but meaningful boundary	
Ongoing and Alternative Boundaries	Nature of the contrast between the ongoing and alternative boundary	Transition from ongoing boundary that is not sticky to alternative boundary that is attractive	Transition from ongoing boundary that is sticky to alternative boundary that is not attractive

FIGURE 1
Consequences of and Influences on Boundary Transitions[2]



[2] The "x" indicates the variant combinations of boundary transition dimensions that may affect transition magnitude. Contingency factors are shown in gray.