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# THE DOUBLE-EDGED SWORD OF LEADERSHIP TASK TRANSITIONS IN EMERGENCY RESPONSE MULTITEAM SYSTEMS

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**Multiteam systems (MTSs) operating in complex and dynamic environments often have a formal hierarchical leadership structure. However, it is unclear whether individuals should stick exclusively to performing their designated tasks within the hierarchical leadership structure, or if, instead, they should switch between different types of tasks to align efforts with changes in the environment. We refer to such task switching—an individual shifting to or from tasks designated for a particular leader position—as leadership task transitions. Our qualitative study of six MTSs responding to live-actor mass-casualty incidents revealed that leadership task transitions are a double-edged sword as they can simultaneously help manage the MTS–environment interface and harm MTS internal functioning. More specifically, leadership task transitions benefit the MTS by rapidly reallocating effort to alleviate the dominant environmental pressure at that time. However, they also harm the MTS by disrupting its internal task-based cycles. Rapidly restoring the disrupted cycles mitigates this harmful effect, but such cycle restoration is not successful when there is a high level of cycle activity or when multiple areas of the MTS are disrupted. Our findings generate new knowledge on how and why leadership task transitions impact MTSs. Implications and future directions are discussed.**

Mass-casualty incidents are a daily occurrence. In 2019, in the United States alone, an estimated 38,000 people were killed, and 4.4 million people were injured, on U.S. roadways (National Safety Council, 2020). In addition, gun-related violence, including 418 mass shootings, resulted in over 39,000 deaths and 29,000 injuries (Gun Violence Archive, 2020). The World Health Organization offers guidelines for mass-casualty incident management systems. They highlight the critical importance of the overall command structure and note that "the success or failure of responses to mass-casualty incidents depends on the cooperation of many sectors" (World Health Organization, 2007: 12). Scholars have referred to such organizational forms—two or more teams (sectors)

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that work interdependently toward the achievement of team and system goal(s)—as multiteam systems (MTSs) (Mathieu, Marks, & Zaccaro, 2001).

Leadership has been theorized to be critically important for MTSs (Mathieu et al., 2001), and is among the most studied topics in the MTS literature (for a review, see Mathieu, Luciano, & DeChurch, 2018; Zaccaro, Dubrow, Torres, & Campbell, 2020). The three leadership theories most commonly applied to MTSs are hierarchical, shared, and functional, and there is empirical evidence supporting the positive effects of each (Mathieu et al., 2018; Zaccaro & DeChurch, 2012). The World Health Organization has specifically recommended a hierarchical leadership structure for mass-casualty incident response, even going as far as to suggest that "training should aim to maintain the integrity of the organizational structure against the panic that may ensue when an incident first arises" (World Health Organization, 2007: 27). The formal command structure, including the tasks associated with each position, is a core element of emergency response training programs (Pollak, Elling, & Smith, 2012). However, like any formal leadership structure, the tasks individuals *actually* perform may be different than those designated for their position. This acknowledges the potential for more leadership fluidity than that revealed by the formal structure, and raises the question of what happens when more fluid leadership behaviors (such as those espoused by shared and functional leadership) occur within a formal structure—in essence interrupting hierarchical leadership.

We explore this leadership fluidity by examining leadership task transitions, which we define as an individual shifting to or from performing tasks designated for a particular leader position. In our context, leadership task transitions involve deviations from the assigned hierarchical leadership structure, and thus include a designated leader performing a worker task, a worker performing a leader task, and, as our MTSs have multiple leadership positions, a designated leader performing a different leader's assigned task. Notably, leadership task transitions, as opposed to leader role transitions (cf. Klein, Ziegert, Knight, & Xiao, 2006), may be brief transitions to perform particular tasks—and do not include a set of recurring behaviors or a shift in expectations (e.g., shifting to whom members look for direction). In other words, leadership task transitions are temporary, accomplished more quickly than role transitions, and do not change the established leadership structure.

The nature of leadership task transitions described above seems well-suited to managing MTSs. Scholars have suggested that MTSs operate in complex and dynamic environments that present multiple problems for the system to solve, many of which may change over time (Mathieu et al., 2001; Zaccaro et al., 2012). Hence, leadership task transitions may provide the agility necessary to respond to such environments, thereby increasing MTS effectiveness. However, *how* (i.e., the process by which) leadership task transitions influence MTS effectiveness remains unknown. Understanding this process is important because it may help to explain why more fluid forms of leadership involving leadership task transitions (e.g., shared and functional) work well in some cases (e.g., wildfire response [Bigley & Roberts, 2001]) while ending in disaster in others (e.g., Hurricane Katrina response [Moynihan, 2007]). Thus, our core research question is: *How do leadership task transitions influence MTS effectiveness in complex and dynamic environments?*

Unfortunately, the existing MTS literature has focused on component team and system processes, but largely ignored the specific tasks that comprise effective MTS functioning (Luciano et al., 2018). Further, the literature has presented the task environment as being both complex and dynamic (e.g., Mathieu et al., 2018), but has failed to explain how it interfaces with the MTS. Therefore, before exploring how leadership task transitions influence MTS effectiveness it is first necessary to unpack how and why the multitude of tasks taking place throughout the MTS work together to function in an effective manner and how such functioning interfaces with the environment. Hence, we split our overarching research question into two subquestions: (a) *How do MTSs function in complex and dynamic environments?* and (b) *How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness?*

To conduct our investigation, we partnered with an emergency medical response academy and a private tactical training company that allowed us to observe and record (video and audio) a large-scale exercise comprised of six mass-casualty incident scenarios. An MTS consisting of 13 individuals responded to each scenario. Each MTS had a two-tier formal hierarchical leadership structure with one system leader overseeing three component teams (sectors), each with one sector leader and three workers. Notably, the tasks designated for each position (e.g., system leader tasks, triage sector leader tasks, treatment worker tasks) are discrete from other positions and these distinctions are a part of mass-casualty incident protocol and emergency responder training (City of Phoenix, 2000; Pollak et al., 2012). Thus, our research setting enabled in-depth examination of leadership task transitions within a hierarchical leadership structure and how they impacted the MTS.

The findings from our inductive qualitative investigation yielded two complementary models, one for each component research question. The first model presents MTS internal functioning in a complex and dynamic environment and illuminates task-based cycles that comprise this functioning and how they interface with the environment (i.e., the MTS–environment interface). The second model builds upon the first by depicting how leadership task transitions influence the MTS–environment interface and MTS internal functioning to impact MTS effectiveness. In short, the core insight from our findings is that leadership task transitions are a double-edged sword as they positively impact MTS effectiveness by better managing the MTS–environment interface and negatively impact it by disrupting MTS internal functioning.

Our study has several implications for the MTS literature and the broader leadership literature. First, we build new theory on leadership task transitions in MTSs by explaining how and why they can be both beneficial and detrimental at the same time. Notably, we identify two processes, one focused on managing the MTS–environment interface and the other on managing MTS internal functioning. Second, by unpacking the MTS–environment interface, we change its conceptualization from a monolithic downward influence of the environment on the MTS to one of dynamic and opposing environmental pressures. Third, by unpacking MTS internal functioning, we illuminate how they are comprised of multiple task-based cycles. In contrast to the extant literature's almost exclusive focus on team and system-level processes and emergent states (Mathieu et al., 2018), examining task-based cycles reveals the task-related elements of MTS internal functioning, thus enabling future MTS research to concurrently explore dynamics associated with both teamwork and taskwork. Finally, our findings speak to the broader leadership literature by suggesting that implementation of hierarchical, shared, and functional approaches to leadership may not be so discrete, but more fluid as shared and functional leadership behaviors may interrupt a hierarchical leadership structure.

## THEORETICAL BACKGROUND

MTSs are a burgeoning area of research (for reviews, see Mathieu et al., 2018; Shuffler & Carter, 2018; Zaccaro et al., 2020). Since their inception, MTSs have been purported to be particularly well-suited for operating in complex and dynamic environments, such as those required for emergency response (Mathieu et al., 2001). This point has been echoed by numerous researchers (e.g., Davison, Hollenbeck, Barnes, Sleesman, & Ilgen, 2012; Luciano, DeChurch, & Mathieu, 2018; Shuffler & Carter, 2018; Zaccaro, Marks, & DeChurch, 2012). In addition, there have been several investigations of MTSs operating in emergency response situations (e.g., Alison, Power, van den Heuvel, Humann, Palasinksi, & Crego, 2015; Power & Alison, 2016; Uitdewilligen & Waller, 2012).

However, the discourse on MTSs has often overlooked the specific dynamics concerning member *tasks*, even though such dynamics may help explain how and why MTSs are able to operate effectively in complex and dynamic environments. Extant empirical studies have acknowledged that these dynamics exist, yet have largely treated the environment as static or impacting the MTS in a singular manner (Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005). Theoretical explanations have simply noted the existence of the MTS–environment interface, suggesting that MTSs "are dynamic and open systems that are highly responsive to their environments" (Mathieu et al., 2001: 290) and that "a primary function of MTSs is to respond adaptively to complex and dynamic circumstances" (Shuffler & Carter, 2018: 398), yet have not explained how this occurs. In sum, despite consensus that "the primary advantage of MTSs is their ability to be highly *responsive* [emphasis added] … on the basis of the performance requirements demanded by the work environment of MTSs" (Marks et al., 2005: 965), it remains unclear precisely *how* MTSs are highly responsive to the environment.

### Leadership in MTSs

Leadership has been posited as an important mechanism for managing MTS functioning and responding to changes in the environment (e.g., Mathieu et al., 2001, 2018), and therefore represents a likely avenue of inquiry regarding MTSs' responsiveness to their environments. In line with Mathieu et al. (2018: 343), we conceptualize leadership in MTSs as "a process, a set of functions that need to be executed for a collective to be successful," and further note that "as a process, leadership may fall to a single individual or to some collective or group of individuals." Notably, the majority of empirically examined MTSs have "a formal, multilevel, hierarchical leadership structure" (Zaccaro et al., 2020: 488). Hierarchical leadership "presumes a top-down influence of the leader on followers, where the leader is the primary originator and conductor of leadership" (Hiller, Day, & Vance, 2006: 388). A formal hierarchical leadership structure aligns the expected and actual flow of information (e.g., updating leaders, directing members) throughout the MTS (Mathieu et al., 2018), thus facilitating communication about changes and required adjustments. Further, the more centralized or hierarchical the structure, the more streamlined the flow of information (Lanaj et al., 2013). Thus, adhering to the hierarchical leadership structure (i.e., not engaging in leadership task transitions) has been associated with better coordination throughout the MTS, and, in turn, improved performance (Davison et al., 2012).

However, other MTS studies have demonstrated the benefits of more fluid forms of leadership, including functional (DeChurch, Burke, Shuffler, Lyons, Doty, & Salas, 2011; DeChurch & Marks, 2006) and shared leadership (Bienefeld & Grote, 2014). In general, the functional approach to leadership suggests that a leader's "main job is *to do, or get done* [emphasis added], whatever is not being adequately handled" by the group (McGrath, 1962: 5; see also Hackman & Walton, 1986). Hence, functional leadership suggests that a formal leader's behaviors may be fluid as they transition between leader and worker tasks. Shared leadership expands this fluidity to both leaders and members, as it conceptualizes leadership as a collectively enacted team property in which many individuals may perform leader or worker tasks (Carson, Tesluk, & Marrone, 2007). Thus, both the functional and shared leadership approaches represent more fluid forms of leadership where different individuals can transition back and forth between performing leader tasks and performing other types of tasks (e.g., worker tasks) to quickly respond to changes in the environment and to address multiple problems.

### Leadership Task Transitions

Focusing on leadership task transitions allows us to examine a foundational element of shared and functional leadership (which include such transitions), in contrast to hierarchical leadership (which does not recommend such transitions) in MTSs. The shared-leadership literature has examined the effects of having multiple individuals engage in leadership, but has largely ignored the effects of switching between leader and worker tasks (D'Innocenzo, Mathieu, & Kukenberger, 2016; Nicolaides et al., 2014). Alternatively, the literature on functional leadership has offered taxonomies regarding which functions (tasks) are important for leadership in a team (Kozlowski, Mak, & Chao, 2016; Morgeson, DeRue, & Karam, 2010), but has not theorized about how a leader shifting between leader and worker tasks influences team effectiveness. Further, neither literature has examined the effects of leadership task transitions on MTS effectiveness—either as a static aggregate phenomenon or as a process that unfolds over time. In short, existing theories have presented conflicting viewpoints of leadership task transitions in complex and dynamic MTS environments, and this conflict is likely to go unresolved until we have theory explaining how leadership task transitions influence MTSs.

Even beyond the MTS literature very little theory has been developed regarding task-related leadership transitions. Scholars have developed theory on leadership *role* transitions (e.g., DeRue & Ashford, 2010; DeRue, Nahrgang, & Ashford, 2015; Klein et al., 2006), but a role involves "a dynamic set of recurring behaviors, both expected and enacted, within a particular group context" (Contractor, DeChurch, Carson, Carter, & Keegan, 2012: 995). This is much broader than a leadership *task* transition—an individual shifting to or from performing tasks designated for a particular leader position—which is not necessarily recurring and comprises only part of a role (cf. Liu & Li, 2012). For example, Klein and colleagues (2006) focused on leader *role* transitions in their study of emergency room attending physicians to examine how dynamic delegation by lead care providers involved a simultaneous shift in the *set* of recurring behaviors (caring for a patient) and the corresponding *expectations* of everyone involved in accomplishing the objective (e.g., the nurses expect that the resident, rather than the attending, is the leader). In other words, individuals switched to and from a leader role.

The distinction between task and role transitions is particularly germane for MTSs, which emphasize the need for frequent and rapid adjustments (Mathieu et al., 2001) that can be accomplished with task transitions rather than a shift in recurring behaviors (i.e., role transition). A role transition changes expectations about communication patterns and the assigned leadership structure, and is therefore challenging to do frequently and quickly. In contrast, a task transition is less disruptive to the MTS than a role transition as it can be done quickly, is temporary, and does not inherently change the leadership structure. Therefore, leadership task transitions may impact the MTS in fundamentally different ways than leader role transitions.

Given the above, we seek to examine leadership fluidity within MTSs by answering the question: *How do leadership task transitions impact MTS effectiveness in complex and dynamic environments?* However, due to the paucity of theorizing on the MTS–environment interface needed to understand how MTSs are responsive to their environments, we first examine *how MTSs function in complex and dynamic environments*. Then, leveraging our enhanced understanding of the MTS–environment interface and MTS internal functioning, we address the puzzle of leadership task transitions in MTSs (i.e., *How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness?*).

## METHODS

### Research Context and Theoretical Sampling

Investigating these research questions required examination of an MTS in a complex and dynamic environment. However, MTSs are often formed to address emergent situations (e.g., multivehicle accidents [Mathieu et al., 2001]), which are by definition unpredictable and therefore challenging to examine. Thus, we chose to examine six live-actor mass-casualty incident simulations (referred to as scenarios) at an emergency medical response academy (hereafter Academy). The Academy conducts these capstone exercises (i.e., full-day events comprised of multiple scenarios) for its 13-month intensive paramedic courses. In each scenario, paramedic students form a different MTS to respond to the mass-casualty incident. After observing two of these exercises and speaking with the Academy's staff and instructors, we determined that it was suitable for our study because: (a) the paramedic classes formed two or more teams that worked directly and interdependently toward a common superordinate goal (i.e., an MTS) (Mathieu et al., 2001), (b) the MTS operated in a complex and dynamic environment, (c) there was a clear hierarchical leadership structure for the exercise with clear delineation of what constituted leader and worker tasks for each position, and (d) from a more practical perspective, the exercise took place in a space that was large enough for members to be dispersed throughout the area yet small enough that we could feasibly capture the vast majority of leadership task transitions using audio and video recordings.[1]

***MTS and leadership structure.*** Thirteen paramedic students (hereafter paramedics) participated in this exercise. All were licensed emergency medical technicians (EMTs) and had experience working as first responders, which assured representative interactions in the mass-casualty incident task environment.[2] For each scenario, there was a hierarchical, formally assigned leadership structure—one individual was designated the system commander, who oversaw three teams of four individuals (one leader and three members)—that delineated specific tasks for each position. The system commander position was assigned system leader tasks, each sector captain position had sector-specific leader tasks, and sector members had sector-specific worker tasks.[3] The tasks required of each sector captain were similar (see Figure 1), and all members were trained for all positions. Therefore, all members had the knowledge to perform any type of task, which, we suggest, increased the likelihood of observing our phenomenon of interest (i.e., leadership task transitions). As this is a main tenet of theoretical sampling (Eisenhardt & Graebner, 2007), it is appropriate for our study.

The superordinate goal of an emergency medical response MTS, and hence the source of between-team interdependence, is to save lives and limbs.

[1]The study is part of a broader data collection effort, which included several unique exercises. The data presented in this article are from one exercise (MCI Exercise Code-1603), which is also used in Sample 3 of Mathieu and colleagues' (2021) team process construct validity paper. None of the variables overlap across these two investigations as completely different coders and coding protocols were used for each project.

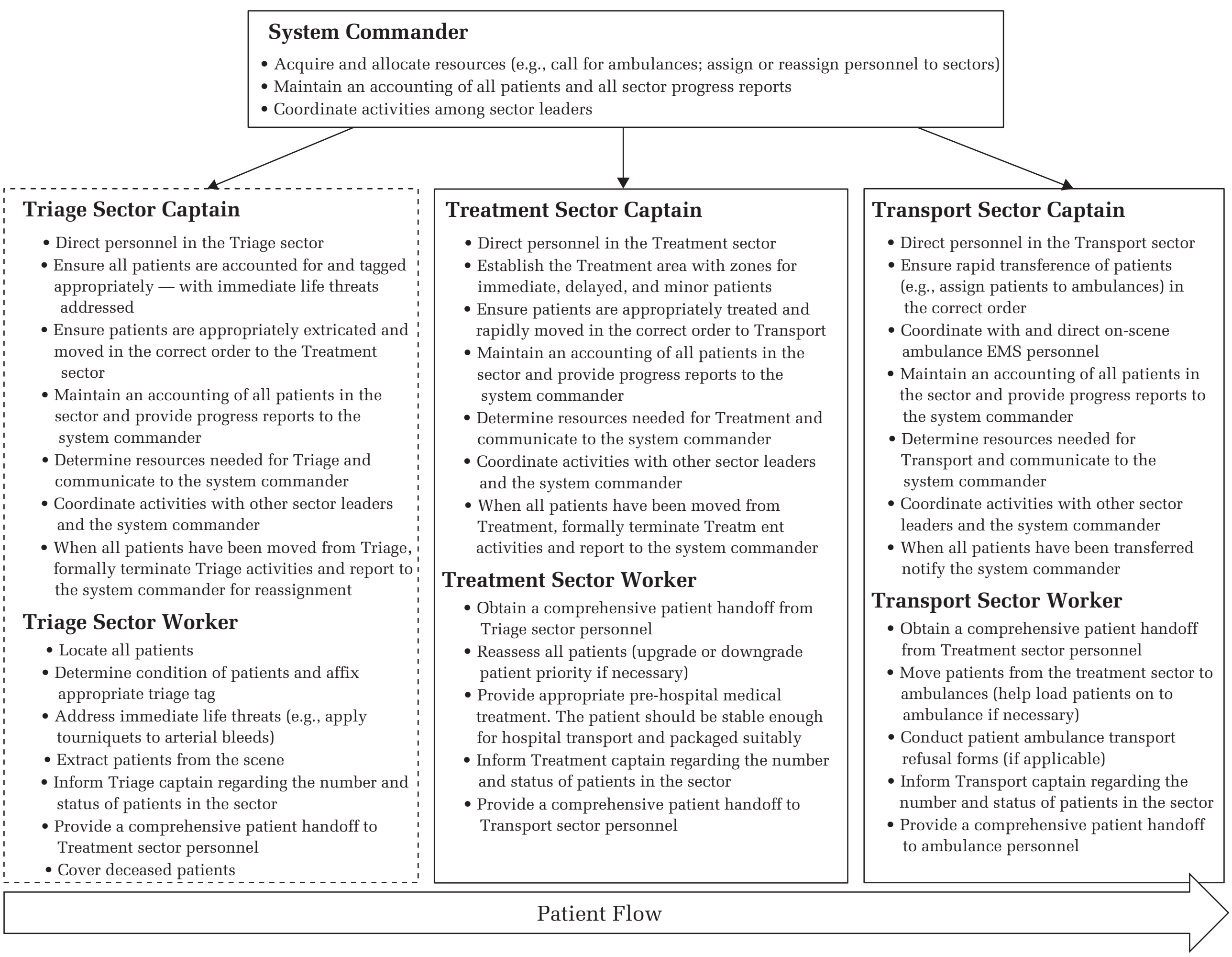
[2]The paramedic class was comprised of 7 (53.85%) males and 6 (46.15%) females. The average age was 26.62 years (*SD* = 6.75) and the majority were White (61.54%) or Hispanic (23.08%), with the remaining students identifying multiple ethnicities (15.38%). All paramedics had recently passed an examination on mass-casualty incident protocol, which assured a shared understanding of the tasks designated for each position. This examination was part of their paramedic class that had met one day a week for the past year. To our knowledge, the paramedics had no interactions prior to enrolling in the program and did not work together outside of the program. Thus, although the paramedics had sat in a classroom together, they had no shared task-specific experience.

[3]Paramedic position assignments were made to maximize the variety of experiences across the exercise (e.g., System commander, Treatment captain, Triage member), but were otherwise random. Thus, all paramedics served in a formal leadership position during the exercise and no paramedic served in the same formal leader position (e.g., Triage captain) twice. This rotation promotes acquisition of broad knowledge about mass-casualty incident response but curtails mastery of position-specific skills and the development of routines. Notably, paramedics were not being trained on leadership task transitions, were not aware of our interest in leadership task transitions, and did not receive any formal feedback related to leadership task transitions.

This involves providing urgent medical care before patients are transported to a hospital or trauma center. In general, the faster all patients are loaded onto ambulances, the fewer the number of deaths and complications from injuries (Aylwin et al., 2006). However, it is also important to deliver the appropriate prehospital care for the injuries or more damage can occur (McCoy, Menchine, Sampson, Anderson, & Kahn, 2013). To accomplish this, each patient should move through the sectors in sequential order, from Triage to Treatment to Transport (i.e., sequential functional process interdependence [Rico, Hinsz, Davison, & Salas, 2018; Thompson, 1967]). Sample tasks in each sector, and the general flow of patients through the three sectors, are provided in Figure 1. Importantly, in each sector the patients most urgently in need of hospital care (referred to as "immediate" patients) should be moved first, followed by patients with less severe injuries ("delayed"), and then patients who do not need urgent care ("minor"). Each of the mass-casualty incident scenarios followed this organization. The goal hierarchy of each MTS was well-aligned, such that tasks related to sector responsibilities were also related to the overarching system responsibilities, akin to the tasks delineated in Type 1 of the framework advanced by Rico, Hinsz, Burke, and Salas (2017: 204) as "component team contributing to proximal and distal goals." Additional information on the MTS structure is presented in Appendix A.

***MTS environment.*** As noted above, the capstone exercise involved six different mass-casualty incident scenarios (three motor vehicle accidents and three mass shootings). On average, each scenario lasted 26:30 (minutes:seconds), with a range of 22:09 to 31:35, based on the initial call from and final call to the dispatcher. Notably, multiple sectors could be active

**FIGURE 1**
**Mass-Casualty Incident Leadership Structure with Sample Tasks Designated for Each Position**



simultaneously based on patient presence (e.g., minor patients still in Triage while more critical patients are in Transport). MTS members could also be reassigned to different sectors during a scenario to align with patient flow (e.g., when the Triage tasks are complete, the system commander may reassign the original Triage members to the Treatment sector). The average duration patients were in Triage, Treatment, and Transport were 14:46, 16:26, and 14:59, respectively.

In each scenario, there were 15 to 16 live-actor "patients." These "patients" were enrolled in an EMT program at the same Academy—although they did not know or interact with the paramedics prior to the exercise. With their medical knowledge, the EMT students were able to accurately present the symptoms of specific injuries. Each patient was assigned a specific location in the scene and corresponding injuries based on the scenario (e.g., the driver of a car *T*-boned on the driver's side had bilateral femur fractures, severe neck pain, and bruising or swelling on the left side of his face). The Academy hired a medically trained makeup artist to apply realistic injuries to the patients, and they were placed in a realistic environment (e.g., cars were pulled up next to each other in a parking lot, ambulances were staged for transporting patients). According to several Academy instructors who served as proctors, the paramedics responded to the actors as if they were real patients, often even going so far as to calm emotional patients.

The exercise took place in approximately 7,000 square feet of space that included several different rooms in the Academy's building as well as part of an adjacent parking lot. The Triage, Treatment, and Transport sectors were located far enough apart that the paramedics in one sector could not hear, and in most cases did not see, paramedics or patients in the other two sectors. Therefore, paramedics were required to physically move patients and transfer information regarding patients from one sector to another.

## Data Collection

To collect rich data without influencing paramedics' actions (see Webb & Weick, 1979), and in line with previous research (e.g., Llewellyn, 2015; Okhuysen & Eisenhardt, 2002), we utilized audio and video recordings as our main data sources. All paramedics wore personal audio-recorders, and we positioned 12 video cameras throughout the space to ensure that every paramedic was recorded at all times. All cameras were placed where they could easily be ignored by the paramedics while maximizing the field of view (e.g., upper corner of a room, 12 feet high on a tree). The paramedics were informed that the recordings would be used for research purposes but were not told the specific research topic in order to avoid such knowledge influencing their behavior. To ensure no leadership task transitions were missed, all recording devices remained on throughout the day, generating more than 180 hours of raw video and personal audio. These types of rich, comprehensive, and permanent data "are particularly well-suited for studying situated action and interaction" (Christianson, 2018: 262), and therefore are a good fit for our research questions.

## Data Analysis

To answer our research questions, we engaged in three phases of data analysis. For the sake of clarity, we present our analysis in a linear fashion with distinct phases. However, as is normal in qualitative research, during analysis we traveled a nonlinear path that involved "conceptual leaping" (Klag & Langley, 2013: 151) based on multiple iterations within and between phases to gain theoretical insight.

***Phase 1: Data preparation.*** We adopted what Knoblauch and Schnettler (2012: 335) referred to as "focused ethnography" to guide our analysis. A focused ethnographic approach using dynamic audio-visual data (rather than other approaches, such as interviews or researcher observations) enabled us to sequentially reconstruct the exercise from the point of view of each paramedic. This data preparation resulted in 78 separate videos, each following a single paramedic (13 total) through each scenario (six total). Thus, we were able to observe everything each paramedic did, said, or heard as they interacted with each other and the patients over time. Additionally, all the video files were time-synchronized, so that at any point in time we could compare the actions of one paramedic with those of others at different locations in the MTS. For example, in scenario 5, when the Treatment captain asks, "Where's my people?" at 12:27, we could see that two people from her team were actively caring for patients in Treatment, and one had just finished moving a patient to Transport and was on his way back to Treatment. Such an approach is useful for analyzing the behavioral foundations of organizational phenomena (Heath & Luff, 2018), especially when scholars wish to unobtrusively capture dynamic data involving situated actions among several individuals within an organization (Christianson, 2018; LeBaron, Jarzabkowski, Pratt, & Fetzer, 2018). This approach allowed us to engage in a robust and detailed analysis of situated actions that influenced MTS-wide phenomena in a manner that is not feasible in real-world mass-casualty incident settings.

***Phase 2: Modeling MTS internal functioning and the MTS–environment interface.*** As noted above, we split our core research question into two subquestions: (a) How do MTSs function in complex and dynamic environments? and (b) How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness? In this phase we focused on answering the first subquestion.

We began with initial coding (Charmaz, 2014; Miles, Huberman, & Saldaña, 2014), which involved identifying or evaluating small chunks of data and was conducted by two teams of coders. One team, consisting of two of the authors, categorized the types of tasks each paramedic was engaged in throughout the exercise. They then identified all task transitions and marked which ones involved an individual shifting to or from performing tasks designated for a particular leader position (i.e., a leadership task transition). As opposed to defining leader tasks based on a particular leadership style, we embraced the idea that leadership is contextual (DeRue & Ashford, 2010). Accordingly, what constituted a leader task for each position was based on the local city protocol for mass-casualty incident response (City of Phoenix, 2000). As this protocol delineates core tasks for each position in a mass-casualty incident (see Figure 1), it enables coding transitions between tasks designated for different positions. For example, communicating a need for more ambulances (i.e., resources) is a Transport captain task. Therefore, in scenario 2, when a Transport member reported to the system commander, "We only have one—one patient left ... We only need one more ambulance" (19:12), it was coded as a leadership task transition as the Transport member was performing tasks designated for the Transport captain position. Across all six scenarios, we captured 1,107 task transitions, 501 of which were leadership task transitions. For coding leadership task transitions, and all other coding, we followed the suggestions of Gioia, Corley, and Hamilton (2013: 22) in that any disagreements regarding coding caused us to "revisit the data, engage in mutual discussions, and develop understandings for arriving at consensual interpretations." Further, we reconciled "differing interpretations by developing consensual decision rules" (Gioia et al., 2013: 22) about how to code the data (see also Guba & Lincoln, 1994).

The second coding team consisted of two medical professionals, both of whom were independent from the research team, who coded paramedic–patient interactions (798 total) for effectiveness. One of the authors assisted them by compiling the data and ensuring methodological rigor. As noted by Mathieu and colleagues (2018: 335), "given [that] the definition of MTS effectiveness hinges on goal accomplishment, the concept is necessarily context dependent." As noted above, the superordinate goal of an emergency medical response MTS is to save the maximum number of lives and limbs, which requires quickly stabilizing and transporting patients to the hospital in the correct order (Aylwin et al., 2006; Pollak, Elling, & Smith, 2012). Hence, the medical professionals coded each interaction for the three main indicators of effectiveness in mass-casualty incidents: (a) quality of care, (b) order of care, and (c) speed of care (Pollak et al., 2012).

As noted above, each mass-casualty incident scenario had patients with specifically assigned injuries. Therefore, the medical coders could accurately assess the quality of patient care, as well as the correct order in which patients should be managed. For example, according to their training (Pollak et al., 2012), paramedics should provide injury-specific treatment and then transport immediate patients prior to treating and transporting delayed patients. Therefore, in scenario 4, when a sector member did not address a patient's life-threatening injuries by applying a tourniquet (5:24–5:53), it was coded as low quality of patient care. Importantly, although the initial coding of effectiveness occurred at the patient interaction level, the quality, order, and speed of care are indicators of effective MTS processes at multiple levels (e.g., worker, sector leader, system leader) and in multiple sectors. For example, the order of care captures the impact of MTS processes associated with appropriately sequencing the order of tasks (e.g., moving the most critically injured patients to the Treatment sector before those with more moderate or minor injuries). Similarly, the speed of care captures the impact of MTS processes associated with duplicated effort and incorrect instructions, both of which slow progress toward MTS objectives (e.g., transporting patients). Hence, our data represent a process phenomenon that has "a fluid character that spreads out over both space and time," and such data "leads, inevitably, to the consideration of multiple levels of analysis that are sometimes difficult to separate from one another" (Langley, 1999: 692). Therefore, our data, while coded at the patient interaction level, are indicative of MTS effectiveness that spans multiple levels of the MTS.

To understand how multiple tasks worked together to achieve MTS functioning, we engaged in "temporal bracketing," which "permits the constitution of comparative units of analysis for the exploration and replication of theoretical ideas" (Langley, 1999: 703). This involved using the initial coding of task types to understand the tasks in which each paramedic was engaged prior to, during, and following a leadership task transition. We then watched the chain of events that led up to, and occurred after, each of the 501 leadership task transitions identified in our initial coding. We often viewed several videos simultaneously to better understand the context (i.e., what was happening in the rest of the sector or system while the leadership task transition was occurring). In this way, we were able to identify regularities in temporal patterns (see Langley & Abdallah, 2011) regarding the types of tasks individuals engaged in and the order in which they were engaged. Through this process a tentative model involving task-based cycles of MTS functioning emerged.

To better understand the interaction between our MTSs and the environment being revealed by our data, we started with the literature regarding the MTS–environment interface (e.g., Shuffler & Carter, 2018), and incorporated the mass-casualty incident literature (e.g., Aylwin et al., 2006; Hirshberg, Frykberg, Mattox, & Stein, 2010). These literatures have suggested that four key environmental factors are likely germane in mass-casualty incidents: uncertainty, volatility, workload, and urgency.

We consulted six medical professionals (two of our coders and four of the instructors who ran the exercise) to better understand the roles of uncertainty, volatility, workload, and urgency, all of whom agreed that these were the four most relevant environmental factors in our context. Importantly, a recurring theme among the medical professionals was that environmental factors influenced paramedic behavior by creating a perceived demand for action. The literature has referred to such perceived demands as *pressures* (cf. Mitchell, Greenbaum, Vogel, Mawritz, & Keating, 2019). Hence, we sought to determine indicators for pressures exerted by the four environmental factors.

Collectively, the same six medical professionals and the authors reached a consensus regarding the criteria for judging the environmental pressure experienced by the paramedics. Uncertainty involves a lack of knowledge and predictability regarding the environment (Duncan, 1972; Gibson & Dibble, 2013). Therefore, judgments regarding pressure exerted by uncertainty were based on verbalizations indicating a lack of knowledge or predictability. Volatility is the amount and rate of instability within a given environment (Bennett & Lemoine, 2014; Gibson & Dibble, 2013), so pressure judgments were based on changes in the status or location of patients or resources over time and within a particular paramedic's purview of responsibility (e.g., multiple patients delivered to Treatment in a short period of time). Workload has been conceptualized as the amount of work compared to the number of individuals available to do that work (Landsman, 2008). Thus, pressure judgments were made by comparing the number of patients who needed medical attention at a given time to the number of paramedics available to provide care for them within a specific sector. Finally, urgency is a result of criticality and time constraint (Morgeson & DeRue, 2006). Therefore, judgments regarding pressure exerted by urgency were based on the criticality (i.e., severity of injuries and consequences if not treated quickly) and level of stability (e.g., the extent to which life-threatening injuries have been treated) of the patients within a specific sector. Once consensus had been reached regarding indicators of the pressures exerted by each environmental factor, three coders (two authors and one medical professional) coded the intensity (low or high) of each of these environmental pressures during, and immediately prior to, every leadership task transition episode (explained in Phase 3 below).

After conceptualizing and coding the pressures exerted by each of the most relevant environmental factors, we once again returned to the literature. In doing so, we discovered that Wood (1986: 71) described dynamic complexity as "changes in the states of the world which have an effect on the relationships between task inputs and products." Uncertainty and volatility, as conceptualized above, both refer to opacity of, and changes in, various states in the environment (i.e., knowledge and predictability of, as well as the amount and rate of instability in, the environment). Thus, we labeled the combined pressures exerted by uncertainty and volatility as *dynamic complexity*. Additionally, Crawford, LePine, and Rich (2010: 842) categorized workload and urgency as types of "challenge demands." Therefore, we labeled the combined pressures exerted by workload and urgency as *dynamic challenge*. We then collapsed our codes for uncertainty and volatility to reflect the level of dynamic complexity and collapsed our codes for workload and urgency to reflect the level of dynamic challenge. Hence, we were able to compare the relative levels of dynamic complexity and dynamic challenge within and between areas of the MTS during each leadership task transition episode.

The analyses above enabled us to develop a tentative model of MTS internal functioning and how it interfaces with a complex and dynamic environment.

Many scholars have suggested that an important way to refine theory is to look for data that are inconsistent with the emerging model (Grodal, Anteby, & Holm, 2020; Miles et al., 2014). Therefore, after a tentative model emerged, we once again returned to the data to assess our model's fit with the data (Huberman & Miles, 1994; Strauss & Corbin, 1990). We watched the videos (13 paramedics) for each scenario, one scenario at a time, as viewing the data in this way enabled us to gain a comprehensive picture of what was happening throughout the MTS when leadership task transitions occurred. In many cases, we watched multiple paramedic videos in parallel so that we could see what other paramedics were doing. Our main goal was to look for evidence that was inconsistent with our developing model (Miles et al., 2014). In doing so, we discovered that there were times when the task-based cycles depicted by our model broke down. These breakdowns were often the result of disruptions to different cycle elements following a leadership task transition.

***Phase 3: Modeling leadership task transitions' impact on MTS effectiveness.*** During this phase, we used the insights gained in our analysis regarding how MTSs function in complex and dynamic environments as a basis for answering our second research question: How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness? In doing so, our analysis revealed that for some of the 501 leadership task transitions identified in our initial coding, we were unable to establish a clear link to impact on MTS effectiveness—defined as the proximal influence of an action on one or more of the indicators for MTS effectiveness (i.e., quality, speed, and order of care). Therefore, using the "following forward" technique (Langley, 2009: 414), we started at each of the previously identified leadership task transitions, and then watched the chain of events unfold until the impact on MTS effectiveness was observed. In the end, 209 of these chains of events revealed a clear link between a leadership task transition and its subsequent impact on MTS effectiveness. For example, in scenario 6 a Treatment member made a radio call, "Treatment to [Transport captain] … do we have an ambo [ambulance] ready?" (10:58), which is considered a leadership task transition because coordinating with Transport is a Treatment captain task (see Figure 1). The patient the member was caring for at that time was then moved to Transport at 11:30. This impacted MTS effectiveness as there were other, more critical patients who should have been moved first. However, a closer look revealed that it was a Transport member who decided the order of patient movement, not that Treatment member. Her decision may have been influenced by the Treatment member asking about available ambulances, or she may have made her own erroneous evaluation as to which patient should go next. The link between the Treatment member's leadership task transition and its impact on MTS effectiveness was not clear, and therefore we did not include it in our analysis. However, the Transport member determining the order of patient movement was also a leadership task transition because that is a Treatment captain task, and its connection to the same impact on MTS effectiveness is clearer. Therefore, we included that leadership task transition in our analysis. All instances in which at least two authors agreed that there was a clear link between a leadership task transition and its impact on MTS effectiveness were included in our analyses (cf. Eisenhardt & Graebner, 2007; cf. Klein et al., 2006).[4] Through this process we identified 209 clear chains of events between a leadership task transition and its corresponding impact on MTS effectiveness, which we refer to as "episodes." Such data condensing often "occurs continuously throughout the life of any qualitatively oriented project" and "is not something separate from analysis. It is part of analysis" (Miles et al., 2014: 12). Notably, each of the 209 episodes identified involved a leadership task transition in which an individual engaged in tasks that were not formally assigned to them, as opposed to returning to their formerly assigned tasks. Additionally, the 209 episodes were dispersed throughout the MTS, across scenarios, and across individual paramedics, and therefore represented a broad spectrum of leadership task transitions.[5]

As noted above, task-based cycles were disrupted following a leadership task transition. To investigate

[4]Notably, *impact* on MTS effectiveness captures changes in effectiveness during a specific episode (output), rather than the single final end-of-scenario aggregation (outcome). For example, if a specific patient is taken out of sequence from triage to treatment, that has a negative impact on MTS effectiveness. The treatment sector may or may not be able to correct that mistake and send that patient in the correct order to transport. However, we focus on the proximal impact as it enables establishing clear links in causal chains and honors the dynamic and multifaceted nature of MTS effectiveness (Mathieu et al., 2018).

[5]Leadership task transition episodes occurred during each scenario ($M$ = 34.83; $SD$ = 8.82) and in each sector ($M$ = 67; $SD$ = 11) and were enacted by each participant ($M$ = 16.38; $SD$ = 5.69). Therefore, our findings represent the "*regularities in temporal patterns*" (Langley & Abdallah, 2011: 211, emphasis in original).

these disruptions, we once again viewed each of the 209 episodes, focusing on these disruptions, how they were related to their corresponding leadership task transitions, and their effect on MTS functioning. We defined a disruption as any disturbance in the baseline flow of a task-based cycle. In our data this took the form of a cycle element not occurring. For example, in scenario 3 the Triage captain was assessing patients, which represents a leadership task transition as this was a Triage worker task. In this way, the task-based cycle was disrupted as updating did not occur. Therefore, the Triage captain was not aware when two more members were assigned to Triage (2:20) so that patients could be assessed and moved more quickly. As a result, the newly assigned members wandered aimlessly for almost a minute (2:48–3:31), with one member exclaiming, "I guess we really can't tell if everybody's [been assessed]" (3:19). During this process, we also discovered that MTS members attempted to restore the task-based cycle following a disruption. We defined cycle restoration as repairing all elements of the task-based cycle such that the flow of the cycle is reestablished. We then reviewed the paramedic videos once again to determine the influence of both task-based cycle disruptions and subsequent attempts at restoring the disrupted cycle(s). In this way we gained a more in-depth understanding of leadership task transitions as a double-edged sword that both positively and negatively impacted MTS effectiveness.

## LEADERSHIP TASK TRANSITIONS IN MULTITEAM SYSTEMS

Our core research question was "How do leadership task transitions influence MTS effectiveness in complex and dynamic environments?" which we split into two component questions. In what follows, we start with the first subquestion, "How do MTSs function in complex and dynamic environments?" Answering this was a necessary step in answering our second subquestion, "How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness?" Therefore, after answering our first subquestion we turn our attention to the second.

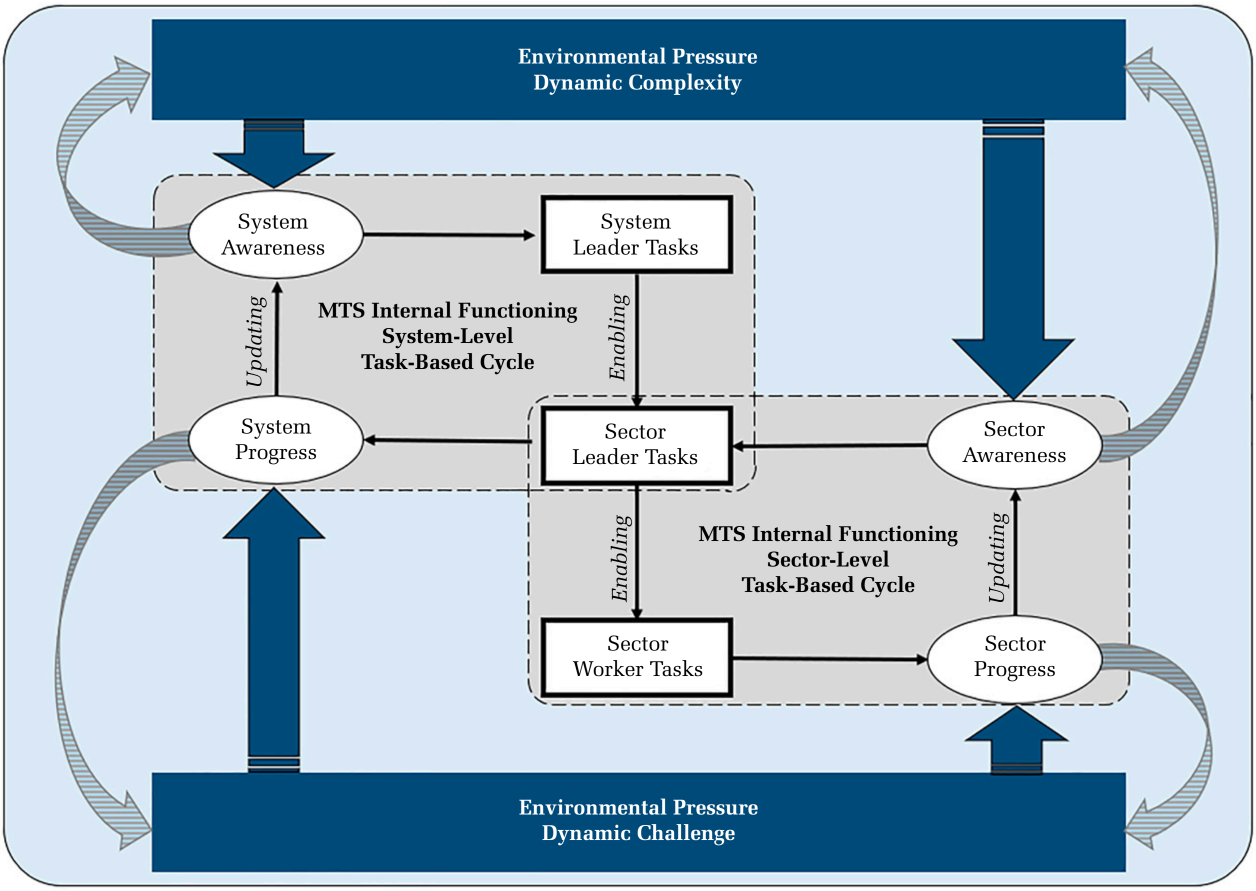
### How do Multiteam Systems Function in Complex and Dynamic Environments?

To aid in understanding our data, we present an overview of Figure 2 prior to showing how this model emerged from our observations. As noted above, our model illustrates the baseline internal functioning of the MTS as well as how such functioning interfaces with the environment. The internal functioning of the MTS is comprised of system- and sector-level task-based cycles (Figure 2, gray areas inside the dashed rectangles).[6] At the core of these task-based cycles are different types of tasks designated for specific positions within the MTS (see Figure 1). These included *system leader tasks*, sector-specific *leader tasks*, and sector-specific *worker tasks* (Figure 2, bold, rectangular boxes). Each leader task is based on a corresponding *awareness* of the area of the MTS in which the task is performed (Figure 2, system or sector awareness with arrows). Further, some leader tasks involve *enabling* lower-level tasks by providing resources for or directing what needs to be accomplished (Figure 2, narrow descending arrows). These lower-level tasks (i.e., sector leader and worker tasks) contribute to *progress* at their respective level (Figure 2, system or sector progress with arrows). That is, sector leader tasks contribute to system progress, and worker tasks contribute to sector progress. Finally, progress, by definition, changes the status of a given area of the MTS. Therefore, *updating*—actions that convey and accrue an accurate understanding of the current status (Figure 2, narrow ascending arrows)—needs to occur so that awareness is gained or maintained, thus starting the cycle over again. The environment interfaces with the internal functioning of the MTSs through environmental pressures (Figure 2, large, dark rectangles) being exerted on awareness and progress in each sector and at the system level (Figure 2, wide, dark arrows). These pressures were, in turn, alleviated as awareness was gained and progress was made in the corresponding task-based cycle (Figure 2, striped, curved arrows). In this section, we illuminate the MTS–environment interface by first showing how the internal functioning of our MTS was formed of several task-based cycles, and then how these cycles interacted with the environment.

***MTS internal functioning: Task-based cycles.*** Examining the MTS task-based cycles allowed us to identify baseline functioning within each specific sector and at the system level of the MTS. For example, in scenario 5, upon arriving on scene the Triage captain communicated with the system commander, "Engine three is on scene" (4:08). Once they had located some patients, she then directed, "[Triage member] count

[6] For the sake of parsimony, Figure 2 depicts the system-level cycle and only one of the three sector-level cycles that were present in our MTS. However, all three sector-level cycles are included in our theorizing.

**FIGURE 2**
**A Process Model of Multiteam System Functioning in Complex and Dynamic Environments**




[the patients]," turned to two other members and added, "And you can start triaging" (4:50). The members then split up to perform the assigned tasks. Later, one member came back and explained, "[I found] one [patient with minor injuries] in there, and she's working on two more [patients]" (5:35). Shortly thereafter, another member reported, "So I got 14 [patients] plus the two that ran out the door" (5:39). After reporting a large number of patients, the same member then informed the Triage captain, "I'm gonna need help [in another room]" (5:46), to which she responded, "Okay" (5:48), and then proceeded to ensure another Triage member went to help him prior to reporting patient numbers and status to the system commander.

As this example illustrates, the baseline task-based cycle (Figure 2, gray areas inside the dashed rectangles) involved *leader tasks* that were based on adequate *awareness* (reporting that the team was on scene). Further, some leader tasks *enabled* lower-level tasks by providing necessary resources or directing actions. Here, the Triage captain directed her members to assess and count patients. These lower-level tasks (e.g., *sector worker tasks*) contributed to *progress* (patients were assessed and counted), and updates regarding that progress were provided. Here, updates were given to the Triage captain, and she was informed that, due to the number of patients, one of her members needed help. Thus, *updating* created *awareness*, and additional *leader tasks* were performed based on that newly acquired awareness, starting the cycle over again. In this example, the Triage captain performed sector leader tasks by ensuring her member had help assessing patients and reporting patient status to the system commander.

***Environmental pressures and the MTS–environment interface.*** Like most MTSs, ours interfaced with a complex and dynamic environment. In our data, the complexity and dynamism were largely a result of opposing environmental pressures that were exerted on different parts of the MTS, the desire to alleviate such pressures, and shifts in these pressures.

***Exerting opposing pressures.*** As opposed to exerting the same type of pressure on all elements of the MTS internal functioning, our data revealed that the environment exerted different types of pressures on specific elements of the task-based cycles described above. For example, in scenario 3, after assessing patients in a vehicle, a Triage member started wandering around the area looking for the Triage captain, "Where's [the Triage captain]...where's [our captain]?" (4:53). Upon finding him she asked, "Do you know how many patients we have? Do you know their [status]?" (5:06). He responded, "We have two deceased. I'm still waiting on... [walks away]" (5:11). After watching the Triage captain walk away, she turned to another Triage member and exclaimed in frustration, "Okay, he needs to communicate with us!" (5:25). Visibly upset, she spotted the Triage captain again and scolded him, "You gotta tell us when they're all [ready] so we know when we can start [moving] them [to Treatment]" (5:32).

In this example, the pressure exerted by the environmental factors of workload and urgency was relatively low. The member had finished assessing patients in one vehicle and was not aware of what else needed to be done. Therefore, she wandered around but did not try to assess other patients. At the same time, the pressure exerted by the environmental factors of uncertainty and volatility was relatively high. A lot had changed while she was assessing patients, leaving the member uncertain regarding what to do next. Hence, she attempted to reduce this uncertainty and gain awareness by asking the Triage captain about patient status. Here, and throughout our data, the pressure exerted *by* the environmental factors of uncertainty and volatility (referred to as dynamic complexity, Figure 2) was exerted *on* gaining awareness (Figure 2, wide, dark, downward arrows). In this case the level of dynamic complexity exerted on gaining awareness only increased after the member's initial attempt to update herself failed as the Triage captain walked away, causing her to publicly scold him.

As another example, in scenario 6 all four Treatment members were caring for patients when another patient showed up (total of eight patients in Treatment). Noticing the extra patient, a Transport member told the Treatment captain, "This guy was kind of just put here and left. Just so you know" (11:56). The captain replied, "He was put here and left? Okay, hey someone from Treatment" (12:05). Upon receiving no answer, he looked around only to see that all Treatment members were already caring for patients. Looking desperate, he walked over to a Triage member who had just dropped off a patient, "If you're Triage, now you're Treatment, can you do [patient] 213 because he's just sitting there and he looks blue [i.e., cyanotic]" (12:15).

Similar to the previous example, this example shows environmental factors exerting pressure on a specific element of the MTS internal functioning. However, in contrast to the previous example, the pressure of dynamic complexity was relatively low because the Treatment captain was aware of the number and status of patients in Treatment. Instead, the pressure exerted by the environmental factors of workload and urgency was relatively high as there were more patients than paramedics to provide care, and a critical patient was not receiving care. Hence, the Treatment captain felt the need to commandeer another member in order to make progress in caring for patients. Throughout our study, the pressure exerted *by* the environmental factors of workload and urgency (referred to as dynamic challenge, Figure 2) was exerted *on* making progress (Figure 2, wide, dark, upward arrows).

Notably, in our data the tasks directed toward gaining awareness or making progress were mutually exclusive. For example, in scenario 6 the Triage captain knew that there were several patients who needed to be assessed but did not know the number and status of all patients in his sector. Therefore, he started to count them only to be interrupted by another member, "I'm gonna need some help moving [this patient] out" (7:07). To which he snapped, "Alright, I need a quick number, though; a quick count!" (7:15), and then proceeded to ignore the other Triage member. The Triage captain experienced the pressures of dynamic complexity (he did not know the status of his sector) and dynamic challenge (many critical patients needed assessment). However, he could not count the patients in his sector to alleviate dynamic complexity and help the other member move a patient to alleviate dynamic challenge at the same time. Indeed, throughout our study, while members sometimes switched quickly between attempting to gain awareness and make progress, they did not do both at the same time. Hence, we refer to the pressures of dynamic complexity and dynamic challenge as opposing pressures.

***Alleviating pressures.*** The environmental pressures of dynamic complexity and dynamic challenge created a demand for the MTS internal functioning to alleviate them. Continuing with the examples from the previous section, in scenario 3, after scolding the Triage captain the Triage member eventually began updating herself regarding sector status by going to each vehicle and observing the status of each patient. By doing so, she was able to gain awareness, which, in turn, helped alleviate the pressure of dynamic complexity (Figure 2, striped, curved arrow) as she had more current knowledge (less uncertainty), and changes in the Triage sector status became known (less volatility). Similarly, in scenario 6, after being directed to do so by the Treatment captain, the former Triage member cared for patient 213. This helped alleviate the pressure of dynamic challenge (Figure 2, striped, curved arrow) as the task was completed (lower workload) and a critical patient was stabilized, thus reducing the risk of death (lower urgency).

These examples show that each opposing environmental pressure created a corresponding demand for a specific element of the task-based cycle (i.e., awareness or progress). Gaining awareness helped alleviate the pressure of dynamic complexity, and making progress helped alleviate the pressure of dynamic challenge. However, the tasks involved in gaining awareness (i.e., knowledge accrual) and making progress (i.e., completing worker tasks) were mutually exclusive, and therefore it was necessary to prioritize effort allocation toward one or the other.

***Shifting pressures.*** Which element(s) of the task-based cycle should be the priority for effort allocation, however, often changed. Different sector or system cycles experienced different types and levels of environmental pressures, which shifted in relative intensity and across different areas of the MTS (e.g., from Triage to Treatment). For example, in scenario 1, when members first arrived they saw that there were five vehicles, each with injured patients inside. Therefore, each Triage member went to a different vehicle and started assessing patients. Focusing solely on the patients in a specific vehicle, each member paid no attention to what the other members were doing or which patients were being assessed outside of their focal vehicle. Eventually, another team showed up to help move patients from Triage to Treatment. Noticing this, and having finished assessing the patients in his vehicle, a Triage member frantically started running from car to car, trying to find the status of all patients in the sector, "What do you guys have over here? Two yellows? I got two delayed and one immediate over there … What about him? [pointing to a patient … Addressing another member], what do you have over here?" (2:57).

This example illustrates how the dominant pressure—whichever pressure was relatively higher—within a given area of the MTS shifted over time. Upon arrival the dominant pressure was that of dynamic challenge (exerted on making progress, Figure 2, wide, dark, upward arrow) as members saw several patients in need of assessment. As members made progress by tagging patients, this pressure was alleviated (Figure 2, striped, curved arrow). However, in making progress the number and status of patients changed, thereby increasing the pressure of dynamic complexity. This became obvious when the other team showed up, and no one in Triage knew which patients they should move first. Thus, the dominant pressure shifted to dynamic complexity (exerted on awareness, Figure 2, wide, dark, downward arrow), and members felt the need to alleviate this pressure by gaining awareness (Figure 2, striped, curved arrow). This prompted one member to scramble from car to car, trying to gain an accurate understanding of the status of patients in his sector.

In addition to the dominant environmental pressure shifting within a given sector, these opposing pressures shifted across sectors over time. For example, in scenario 2, Triage members focused almost solely on moving patients from Triage to Treatment and were able to move all "living" patients in the shortest time of any scenario (approximately 7.5 minutes, from 2:03–9:32). However, their focus on moving patients resulted in patients being moved without first having their injuries fully assessed. Indeed, one member moved three patients without assessing any injuries, and without actually escorting them to Treatment. Instead, he only pointed at a building, saying, "You're going to go in there and talk to them" (4:24) as he walked away from the patient. On another occasion, when a Triage member was asked the status of patients he had already moved to Treatment, he answered, "They'll figure that out" (6:15). Thus, a large number of patients showed up in Treatment in a very short amount of time, without having their life-threatening injuries addressed and with no indication of how critical their injuries were.

The dynamic challenge in Triage was rapidly alleviated as members moved all patients to Treatment. However, the level of dynamic challenge was not actually alleviated in the MTS, but simply flowed from one area of the MTS to another (i.e., Triage to Treatment). This resulted in Treatment members having substantially higher levels of dynamic challenge and dynamic complexity than they were expecting or had the resources to alleviate. Here, and throughout our study, the less effective a given area of the MTS was at alleviating opposing environmental pressures, the more such pressures were felt in other areas.

As noted above, the environmental pressures of dynamic complexity and dynamic challenge were exerted on the task-based cycle elements of awareness and progress, respectively, within a given area of the MTS (i.e., sector or MTS level). Therefore, as the MTS alleviated these environmental pressures, or as they flowed with the patients throughout the MTS (e.g., from Triage to Treatment), the pressures on awareness and progress changed. Within the MTS, environmental pressures shifted between sectors. Within sectors, the dominant pressure often shifted from dynamic challenge to dynamic complexity, and back again.

***Summary.*** Our first research subquestion sought to explain how MTSs function in complex and dynamic environments. Our data revealed that MTS internal functioning is composed of system- and sector-level task-based cycles (Figure 2, gray areas inside the dashed rectangles), and opposing environmental pressures are exerted on specific elements within these task-based cycles (i.e., awareness or progress, Figure 2, wide, dark arrows). The MTS alleviated these pressures by carrying out the tasks necessary to either gain awareness or make progress (Figure 2, striped, curved arrows). However, which environmental pressure was dominant often shifted within and between areas of the MTS, and such shifts in environmental pressures created a demand for a corresponding shift in effort allocation within the MTS's internal functioning.

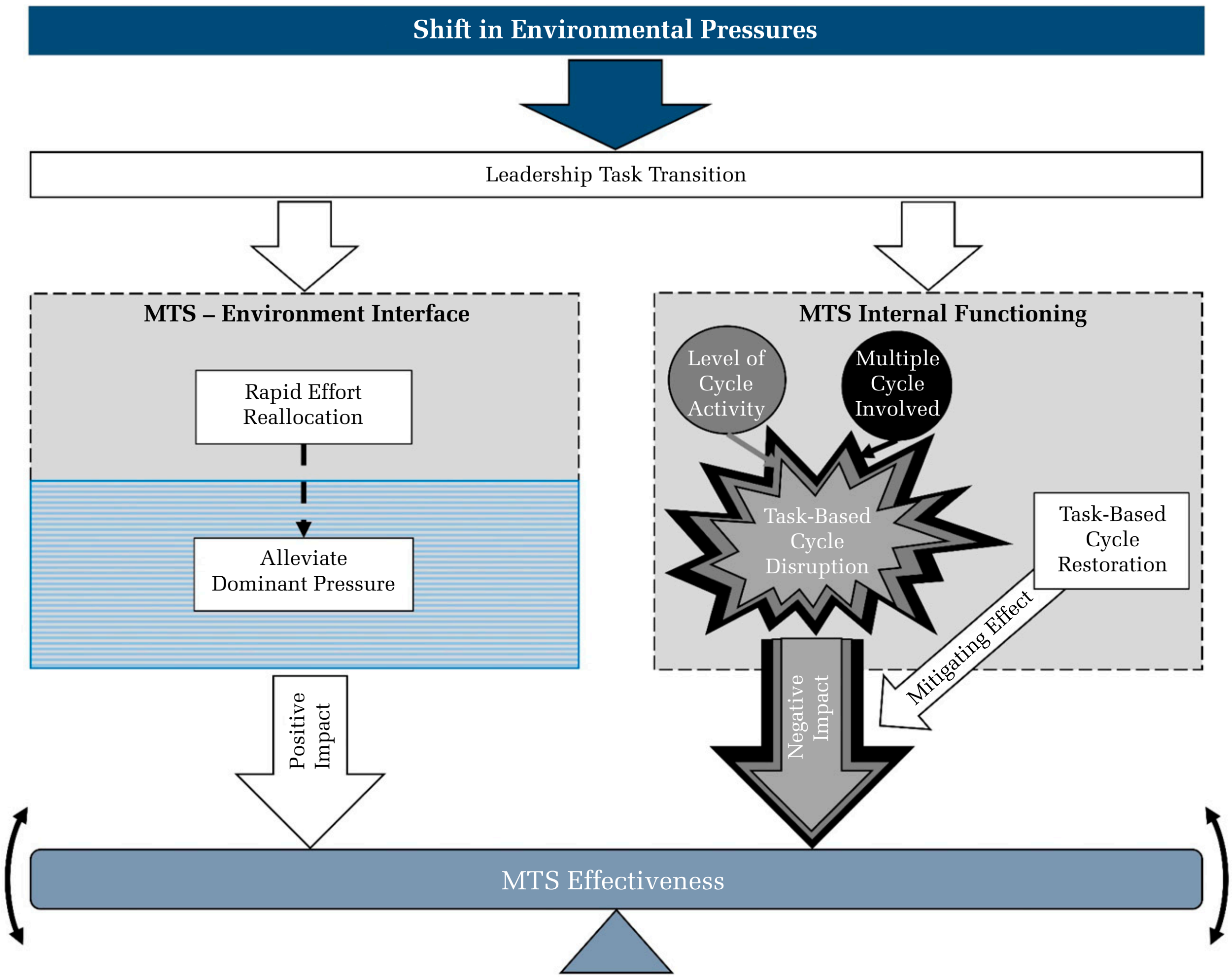
### How do Leadership Task Transitions Influence Multiteam System Functioning?

After gaining insight regarding the task-based internal functioning of the MTS and how it interfaced with the environment (Figure 2), it was possible to examine how leadership task transitions influenced these processes to impact MTS effectiveness. Our data revealed that leadership task transitions helped manage the MTS–environment interface. However, in doing so each leadership task transition also incurred a cost in terms of disrupting one or more task-based cycles that comprise the internal functioning of the MTS. As an overview, and as depicted in Figure 3, a shift in environmental pressures served as a trigger for a leadership task transition. The leadership task transition then created two processes. The first process, shown on the left side of Figure 3, involved managing the MTS–environment interface by rapidly reallocating effort between elements of the task-based cycle(s) (e.g., from leader tasks to worker tasks in a given sector) in order to alleviate the new dominant pressure created by the shift. This process positively impacted MTS effectiveness (bottom of Figure 3). However, effort being reallocated *to* a given element of a task-based cycle meant that effort was taken away *from* another, either in the same or in a different cycle within the MTS. Therefore, as shown on the right side of Figure 3, a leadership task transition also created a second process in which the MTS internal functioning (i.e., one or more task-based cycles) was disrupted. In general, the level of cycle activity and number of disrupted cycles increased the extent of the disruption. Such disruptions had a negative impact on MTS effectiveness. This negative impact was mitigated, however, in cases where the task-based cycle was successfully restored (Figure 3). Hence, each leadership task transition represented a double-edged sword that both positively and negatively impacted MTS effectiveness, with the net impact of the leadership task transition dependent on whether the disrupted task-based cycle was successfully restored. In this section, we explain how shifts in environmental pressures triggered leadership task transitions. We then explain the nature of the double-edged sword created by leadership task transitions and show how they sometimes resulted in a net positive, and sometimes a net negative, impact on MTS effectiveness.

***Shifts in environmental pressures trigger leadership task transitions.*** As noted above, environmental pressures shifted between areas of the MTS (i.e., Triage, Treatment, Transport, or System task-based cycles) and also between which pressure was dominant within a given area of the MTS. Whether between different areas of the MTS or within a given area, a shift in environmental pressures often triggered a leadership task transition. For example, in scenario 5 the Treatment captain discovered that one of the patients already in Treatment was near death, and two others had arrived in Treatment unexpectedly. In an effort to ensure each new patient was being cared for, she directed a member, "Okay, go ahead and give [Treatment member] the report and have him look after [the patient]" (16:52), and then turned to a different member, "I got a person over here that just wandered in. Can you help her out?" (17:34). Scanning the Treatment area, she then asked, "Who's ready to transport when we get another [ambulance]?" (18:17). Finding that only one of the three patients was ready for transport, she turned to another member, "We're waiting on what [exactly]?" (18:24). After being told the patient was still being assessed, she called Dispatch, "Dispatch, what's the ETA [expected time of arrival] on another ambo?" (18:31). She was told that an ambulance would arrive within a few seconds.

In this example, dynamic challenge was initially the dominant pressure. As such, the Treatment captain

FIGURE 3
**The Double-Edged Sword of Leadership Task Transitions**




focused on sector progress by ensuring that all patients were being cared for. However, as patients started receiving care, dynamic challenge was alleviated and the dominant pressure shifted to dynamic complexity as the order in which patients should be transported was not known. In response to this shift, the Treatment captain attempted to update herself on the status of each patient, and more specifically how long it would be until they were ready for transport. However, she quickly realized she did not know when the next ambulance would arrive. This was important because a patient could not be transported until their injuries were stabilized, even if they were more critically injured than another patient. Therefore, the Treatment captain engaged in a leadership task transition by switching from doing sector leader tasks (updating the status of the patients in her sector) to system leader tasks (communicating with Dispatch regarding ambulance arrivals) in order to gain this critical awareness, and in doing so help alleviate the new dominant pressure of dynamic complexity.

In the example above, and throughout our study, shifts in environmental pressures triggered leadership task transitions (Figure 3). Further, every leadership task transition resulted in a double-edged sword created by dual processes, one of which had a positive impact on MTS effectiveness and one of which had a negative impact.

***Leadership task transitions: The positive impact of rapid effort reallocation.*** The first process created by a leadership task transition positively impacted MTS effectiveness. For instance, in scenario 4 the system commander was walking through the building counting the number of patients that had not been moved to Treatment yet. After counting several patients she exclaimed in frustration, “We’re taking forever to get [patients] moved [from Triage to Treatment]” (14:28). Seeing some Triage members, she stopped them in the hall, “Just start taking patients out to the Treatment area” (14:40). She waited until she saw the members start assessing patients, and then walked away, stating in exasperation, “If it wasn’t for me, we wouldn’t have half these guys triaged” (15:07). Meanwhile, two of the members she directed assessed and then moved two patients from Triage to Treatment.

Here, the dominant pressure had shifted from dynamic complexity to dynamic challenge as the system commander updated her awareness regarding the number of patients who *still* needed to be moved out of Triage, even though they were more than 14 minutes into the scenario. In response, the system commander engaged in a leadership task transition when she switched from performing system leader tasks (maintaining an account of the number and status of patients in the system) to sector leader tasks (directing sector members to move patients). As she started directing various members to move specific patients out of Triage, this rapidly reallocated effort toward alleviating the new dominant pressure of dynamic challenge. As a result, two patients who had received no medical attention up to that point were assessed and moved to Treatment in a timely manner. Thus, the leadership task transition positively impacted MTS effectiveness by increasing the quality and speed of care of those two patients. In short, a leadership task transition created a process that rapidly reallocated effort that alleviated the dominant pressure (here, dynamic challenge), and in doing so positively impacted MTS effectiveness (Figure 3, left side).

***Leadership task transitions: The negative impact of task-based cycle disruptions.*** Although leadership task transitions helped alleviate the dominant environmental pressure in a given area of the MTS, they also incurred a cost. For example, in scenario 1, at 6:30 there were three patients in Treatment with only two paramedics to care for them. Upon seeing that a critical patient was in need of care, the Treatment captain started assessing their injuries, “Okay, so where are you bleeding from?” (7:01). After stabilizing the first patient, she noticed another patient in her immediate vicinity, and started caring for that patient as well (at 9:38). The Treatment captain then coordinated with Transport members to get both patients loaded onto ambulances, “So 212 and 213 ... we’re gonna take you [to the ambulances]” (11:43).

While the Treatment captain was caring for patients (7:01–11:43), a lot was going on in the Treatment sector that she failed to notice. First, patient 207’s injuries were assessed as life threatening, “I need to retriage this patient as [an] immediate” (8:49), yet no one stabilized those injuries. Second, two more patients arrived in Treatment (at 10:04 and 10:29) for a total of six patients that needed care. Finally, instead of assessing patients, the two Treatment members who had brought in one of the new patients (at 10:04) just stood around until a Triage member asked, “Are you Treatment?” (10:34). Looking confused, they answered, “We’re just bringing [patients] back and forth [from Triage]” (10:36). The Triage member then dropped off his patient and left. Still looking confused, the Treatment members eventually started caring for the new patients, “So we’re going to get an IV established” (11:14). However, both of these patients were less critically injured than patient 207, who had still not received medical attention.

In this example, the Treatment captain engaged in a leadership task transition when she started performing worker tasks (i.e., caring for patients). During this time (7:01–11:43), the task-based cycle in Treatment was disrupted in two ways. First, the Treatment captain did not notice, nor did other members attempt to inform her, that three Treatment members were caring for patients with less severe injuries than another patient who had yet to receive care. Hence, the task-based cycle element of *updating* ceased and, in turn, the Treatment captain’s sector *awareness* suffered. Second, because she lacked awareness, when the Treatment captain started doing sector leader tasks again (i.e., coordinating with Transport), she failed to direct other Treatment members to care for the most critical patients first. Therefore, the task-based cycle element of *enabling* also ceased. These disruptions to the task-based cycle hindered both the speed and order of care for a critically injured patient, thus negatively impacting MTS effectiveness (Figure 3, right side).

***The mitigating effect of task-based cycle restoration.*** Throughout our study, each leadership task transition created a process that negatively impacted MTS effectiveness through task-based cycle disruption. However, in some cases it was possible to mitigate this negative impact by rapidly restoring all elements in the disrupted cycle. This was the case in scenario 3 when there were five patients and only three Treatment members to care for them. After scanning the sector, the Treatment captain started assessing a patient, "Shit, there are too many [stoops down to treat a patient]. Hey man, what's going on?" (7:57). He continued to care for patients until 9:36. During this time, Triage members dropped off two more patients in Treatment (at 8:33 and 8:47) with little or no information regarding the status of their injuries. Looking confused, a Treatment member asked one of the Triage members, "Will you guys bring the red ones [i.e., immediates]? We only have one" (8:48). She then looked at one of the new patients, "She's an immediate. Why is she in here?" (8:58). Eventually, she went back to assessing patients, "All right ma'am. What's hurting you today?" (9:25). At 9:36 the Treatment captain finished stabilizing his patient. Standing up, he walked around his sector noting the number and status of patients. He then coordinated with a Transport member to move patients, "There are three patients that are *c*-spined, [patient] 203 is good to roll, [patient] 202 is good to roll … Can you get another Transport [member]?" (9:50). The Transport members then moved four patients into waiting ambulances.

Similar to the previous example, here the Treatment captain engaged in a leadership task transition when he started caring for a patient, and while doing so he did not notice, nor did anyone attempt to inform him, that new patients had arrived. He also did not direct his members to assess patients instead of asking for more "red" patients, or direct Triage members to provide an update on patient injuries prior to going back to the Triage sector. In other words, the elements of *updating* and *enabling* had ceased, and the task-based cycle in Treatment was disrupted. Like in the previous example, this disruption resulted in care being delayed for the newly arrived patients and a lack of awareness regarding their injuries.

However, whereas in the previous example the Treatment captain simply went back to performing sector leader tasks in an attempt to restore the task-based cycle functioning, here the Treatment captain fully restored *all elements* of the task-based cycle. More specifically, he first engaged in *updating* by scanning the sector and noting patient status. In doing so he gained the *awareness* necessary to perform the *sector leader task* of coordinating with Transport. He then *enabled* his members by directing which patients to take and in which order to take them. Finally, his members worked with Transport members to perform *worker tasks* (i.e., providing patient status and moving patients) that contributed to *progress* as patients were moved to Transport. Importantly, in this example, as in the previous example, disrupting the task-based cycle hindered the speed and order of patient care, thus negatively impacting MTS effectiveness. However, in the previous example the Treatment captain only restored part of the task-based cycle when she went back to doing sector leader tasks. In contrast, in this example the Treatment captain rapidly restored the entire task-based cycle, and in doing so mitigated the negative impact of the disruption on MTS effectiveness. Thus, in the end, all patients were moved in the correct order as quickly as the ambulances could receive them. Here, and throughout our study, rapid restoration of the disrupted task-based cycle mitigated the negative impact on MTS effectiveness.

***The net impact on MTS effectiveness.*** Our data revealed that for every leadership task transition, an attempt was made to restore the disrupted task-based cycle or cycles. When *all elements* of the disrupted cycle were restored (i.e., updating, awareness, leader tasks, enabling, worker tasks, and progress), such restoration successfully mitigated the negative impact of the task-based cycle disruption. In these cases (139 out of 209), the positive impact on MTS effectiveness outweighed the negative, and thus the leadership task transition had a net positive impact on MTS effectiveness. When only some elements of the task-based cycles were restored (70 out of 209), the mitigating effect was not enough for the positive impact of rapid effort reallocation to outweigh the negative impact of cycle disruption, and the net impact on MTS effectiveness was negative. Of the 70 instances where the entire task-based cycle was not successfully restored, 34 involved the individual simply returning to the previous tasks and thereby short-circuiting the process by not first engaging in updating and in turn gaining awareness. In the remaining 36 cases, individuals were unable to restore the entire task-based cycle, either because the level of cycle activity was high or because multiple task-based cycles were disrupted.

***Level of cycle activity.*** During certain times in our MTSs, the level of task-based cycle activity (i.e., totality of actions occurring in the task-based cycle) was so high that attempts to restore every element of a task-based cycle were unsuccessful. For example, in scenario 4 there were seven patients in Treatment and two ambulances ready to take them to the hospital. However, no one from Transport was available to move the patients, leading the Treatment captain to ask, "Where's Transport? … I don't know where my transportation sector is" (10:46). He then tried to call Transport on the radio at 11:35, and again at 11:56, receiving no response. As the Treatment captain was waiting for Transport members to show up, and becoming visibly frustrated, one of his members reported that the medical status of some patients was deteriorating, "His pulse is thready and his blood pressure is dropping" (14:03). In response, the Treatment captain tried to reassign members from Triage to Treatment, "Can I get additional bodies [i.e., paramedics]? I need help [moving] some patients out of here. If I can split your guys' group up?" (14:11). While waiting for an answer, which never came, the Treatment captain did not notice the arrival of patient 212. When Transportation members finally showed up, the Treatment captain tried to coordinate patient transport, "Okay, we have two immediates. Both of them need to go, [points to minor patients] those two can go with. We have two [ambulances] already on scene so let's load them up and get them out of here" (15:06). At this time there were actually four immediate patients, and two delayed patients who should have been transported prior to the minor patients to which the Treatment captain pointed. The system commander then requested the status of all patients in Treatment, "What's your count out there?" (15:34). The Treatment captain scanned his sector and started reporting the count. However, as he was speaking, one patient (205) was moved to Transport and two other patients arrived in Treatment (208 at 15:38 and 213 at 15:51). He then started to scan his sector again, but was interrupted by a Transport member, "Can you give me a report on one of these [patients]?" (16:19). To which he replied, "I don't know who it was [that cared for them]" (16:23). During this interaction he failed to notice the arrival of another patient (206). He once again started scanning his sector, only to be interrupted by an announcement from Dispatch, "All requested ambulance units are on scene" (16:33). This prompted him to ask, "[Transport member], both immediates are already in [the ambulances], right?" (16:54). As he was speaking, he failed to notice three additional paramedics who arrived to help care for patients. In a final attempt to gain awareness of the status of patients in his sector, he asked a Treatment member, "[Transport member] where are we at right now? Who needs to [be transported] right now?" (17:04). However, as the member was trying to report the status of the 10 patients in Treatment, looking overwhelmed, he simply walked away (17:23)—leaving five immediate patients waiting to be transferred to ambulances with no clear direction regarding the order in which they should go.

In this example, the Treatment captain engaged in a leadership task transition when he tried to reassign Triage members to help move patients. During this time updating ceased as the Treatment captain did not notice the arrival of another patient nor which patients had been cared for and were ready to move, and Treatment members did not report to him. After the Transport members arrived, the Treatment captain made several attempts to restore the task-based cycle in Treatment, repeatedly scanning his sector to get an idea of how many patients there were and the level of their injuries. However, because the level of cycle activity was so high, he was continually interrupted. Hence, he missed the arrival of four new patients and three paramedics, was not sure which patients had already been moved, and had no idea regarding the number of remaining patients or the order in which they should be transported. In short, because the level of task-based cycle activity was so high, the disruption caused by the leadership task transition quickly spun out of control. Therefore, attempts at restoration were not successful.

Here, and throughout our study, whenever the level of cycle activity was high, the task-based cycle disruption caused by a leadership task transition was notably greater (Figure 3), and rapid restoration of all task-based cycle elements was not successful. Because the entire task-based cycle was not restored, the mitigating effect of such restoration was limited (Figure 3). Thus, when the level of cycle activity was high, the net impact of a leadership task transition on MTS effectiveness was negative.

***Multiple cycles involved.*** On occasion, a single leadership task transition resulted in a disruption that went beyond the boundaries of one sector to another sector or to the system level (i.e., multiple cycles were involved, Figure 3).[7] For example, in scenario 2, at 10:03 six of the eight patients in Treatment were stabilized and ready to move to Transport. However, Transport members were nowhere to be seen. Thus, the Treatment captain was becoming more and more agitated, impatiently tapping his notebook against his leg and repeatedly glaring at the Transport area. Following one such glare, he left Treatment and walked over to two members in Transport, "Hey, you guys are Transport? So we need to get these [patients] out. Right now!" (10:10). The Treatment captain then continued to direct Transport members, "Let's get them out. If we got [patients with life-threatening injuries] let's go!" (11:14). While he was away, his own members had no idea where he had gone. When a Triage member asked where the Treatment captain was, a Treatment member responded, "I don't know where [the Treatment captain] is. [He] isn't here" (10:26).

[7] Lateral (i.e., between-team) leadership task transitions inherently disrupted multiple cycles. However, vertical leadership task transitions also had the potential to disrupt multiple cycles.

Hence, the Treatment captain became unaware of changes in the status of patients' injuries in his sector and which patients had been stabilized and were ready to move. Eventually, the Treatment captain went back into Treatment, scanned the area without asking his members for an update, and then continued to direct a Transport member, "Let's get him [pointing at patient 209] 'cause he's gonna be next out. [Looks around] [The rest] are all [patients with minor injuries] so ... " (12:28). The Transport member then asked, "What's wrong with [patient 209]?" (12:35), to which the Treatment captain responded, "I don't know. That's what I was wondering" (12:37). Because stabilizing a patient is required prior to moving them, the member then bent down to assess patient 209. He finally completed the assessment (at 14:23), and then moved the patient to Transport.

Meanwhile, when the Treatment captain started directing Transport members at 10:10, they stopped providing updates regarding patient status to the Transport captain. After nearly three minutes without an update, the Transport captain specifically asked a member, "Can you update me on patients 'cause [Transport members have not]?" (12:59). The member then went into the Treatment area and tried to count patients. However, because no single person in Treatment was aware of the status of all patients, she ended up reporting an inaccurate count, "Four minor [and] one delayed. So, five altogether" (14:10). At that time there were actually seven total patients in Treatment, three of which were delayed. The Transport captain then impatiently responded, "We have three [ambulances] on scene. Let's get 'em out!" (14:14).

Ideally, MTS component team leaders communicate with each other when concerned about another team's progress (e.g., Davison et al., 2012). However, in this example the Treatment captain instead engaged in a leadership task transition by switching from performing Treatment sector leader tasks to performing Transport sector leader tasks (i.e., directing Transport members to move patients). This disrupted the task-based cycle in the Treatment sector as updating ceased because no one knew where the Treatment captain was. Additionally, because the Treatment captain started directing Transport members, updating in the Transport task-based cycle had ceased as well (i.e., the Transport captain was not being updated). This left her waiting in the Transport sector, wondering why no patients were showing up. Hence, the Treatment captain's leadership task transition disrupted both the Treatment and Transport task-based cycle (i.e., multiple cycles were involved, Figure 3).

Both sector captains attempted to restore their respective task-based cycles. However, because the Treatment captain was busy directing Transport members, he did not get a report from each of his own members regarding patient status. Instead he conducted a cursory scan of his sector, and then proceeded to direct a Transport member to move patient 209, having no idea what was wrong with the patient or whether he was ready to move. In response, the Transport member assessed the patient's injuries prior to moving him, not knowing that patient 209 had already been stabilized (at 10:30) and was ready to move. The Transport captain attempted to restore her task-based cycle by asking one of her members to get the status of patients who still needed to be transported. However, due to the breakdown of awareness in the Treatment sector's task-based cycle, the Transport member was unable to do this and ended up giving the Transport captain an inaccurate report. Importantly, the Transport member that was assessing patient 209 and the Transport member attempting to get an accurate count of patients could have both been moving patients at that time. Thus, somewhat ironically, the leadership task transition that was aimed at speeding up the care and transport of patients ended up slowing it down instead. Here, and throughout our study, when a disruption created by a leadership task transition involved multiple task-based cycles, attempts to restore these cycles were not successful. Disruptions involving multiple cycles were simply too large, and therefore, in such cases, the net impact on MTS effectiveness was negative (Figure 3).

***Summary.*** Our second research subquestion was: How do leadership task transitions influence MTS functioning and, in turn, impact MTS effectiveness? As depicted in Figure 3, our data revealed that shifting environmental pressures prompted leadership task transitions, which, in turn, triggered two different processes. One process helped manage the MTS–environment interface by rapidly reallocating effort between different parts of the task-based cycles (i.e., toward making progress or gaining awareness). This effort reallocation helped alleviate the dominant pressure in a given area of the MTS, and in doing so positively impacted MTS effectiveness. However, the cost of such effort reallocation was a disruption to one or more task-based cycles that formed the MTS internal functioning. Hence, each leadership task transition also triggered another process that negatively impacted MTS effectiveness. When every element of the disrupted task-based cycle was restored, the negative impact of task-based cycle disruption was mitigated, and the leadership task transition had a net positive impact on MTS effectiveness.

Unfortunately, when such restoration did not occur, the mitigating effect of cycle restoration attempts was minimal, and the leadership task transition had a net negative impact on MTS effectiveness. Throughout our study, this was the case whenever the level of cycle activity was high or multiple cycles were involved in the disruption.

## DISCUSSION

We examined emergency response MTSs during live actor mass-casualty incidents, and in doing so answered the subquestions: (a) How do MTSs function in complex and dynamic environments? and (b) How do leadership task transitions influence this functioning and, in turn, impact MTS effectiveness? Regarding the first subquestion, our data revealed that MTS functioning is comprised of task-based cycles that exist at the sector and system levels (Figure 2). These cycles consist of leader tasks that are based on awareness, some of which enable lower-level tasks by providing direction or resources. The lower-level tasks, in turn, contribute to progress and, once such progress occurs, updating is necessary to gain new awareness on which future leader tasks should be based. Further, we identified the opposing environmental pressures of dynamic complexity and dynamic challenge and explained how these pressures interface with MTS internal functioning. More specifically, the environmental pressures are exerted on different elements of the task-based cycle (i.e., awareness or progress). In turn, when these task-based cycle elements are achieved (i.e., awareness is gained or progress is made), they alleviate the respective environmental pressure. Integrating these findings, we advanced an empirically grounded, multilevel, task-based process model of MTS functioning, which illuminated the intricacies of MTS internal functioning as well as the multifaceted relationship at the MTS–environment interface.

We then leveraged these insights on the MTS–environment interface and MTS internal functioning to address the second research subquestion regarding the impact of leadership task transitions on MTS effectiveness (Figure 3). We found that leadership task transitions are a double-edged sword. On one hand, they help manage the MTS–environment interface by rapidly reallocating effort to alleviate the current dominant pressure, which positively impacts MTS effectiveness. On the other hand, leadership task transitions inevitably disrupt one or more task-based cycles, thereby harming MTS internal functioning and negatively impacting MTS effectiveness. Notably, this negative impact can be mitigated by rapidly restoring the disrupted cycle. In these cases, the benefits of managing the MTS–environment interface outweigh the costs, such that the net impact of the leadership task transition on MTS effectiveness was positive. However, attempts at cycle restoration were not successful when there were high levels of cycle activity or multiple cycles were disrupted. In such cases, the cost of the leadership task transition outweighed the benefits and the net impact on MTS effectiveness was negative. These findings bring inductive insights to a literature stream that has been primarily deductive and experimental, and have important implications for MTS and leadership theories.

### Theoretical Implications

Our study builds new theory on how and why leadership task transitions impact MTS effectiveness. Notably, the theoretical insights derived about MTS internal functioning and the MTS–environment interface enabled identification of the dual processes by which leadership task transitions impact MTS effectiveness. More specifically, our findings illuminate how leadership task transitions are simultaneously beneficial and detrimental to the MTS. We reveal the importance of managing the MTS–environment interface so as to be responsive to changes in the environment while also maintaining, or quickly restoring, baseline functioning of the task-based cycles that comprise MTS internal functioning. Understanding the dual processes of leadership task transitions, and their disparate impact on MTS effectiveness, shifts the focus from the overall aggregate MTS effectiveness to the impact of many different episodes along the way.

Focusing on the more proximal impacts on MTS effectiveness not only facilitates the development of a more dynamic theory of MTSs but may also clarify the mechanisms that underlie countervailing effects and yield more accurate and actionable recommendations. This implication may be particularly important for constructs that are theorized to have countervailing effects in MTSs, but have yet to be empirically examined (e.g., trust, competition [DeChurch & Zaccaro, 2013]). Indeed, constructs like trust may have both countervailing effects across the team and system levels as well as dual processes within levels (Colquitt, LePine, Piccolo, Zapata, & Rich, 2012), and important congruence considerations (Baer, Frank, Matta, Luciano, & Wellman, 2021). By examining the positive and negative effects wherever and whenever they manifest, the MTS literature may develop a more nuanced and actionable understanding of mixed effects, as opposed to artificially restricting them to different levels.

We also offer an exposition of MTS internal functioning by unpacking its task-based cycles. By illuminating both the content (e.g., leader tasks, sector awareness) and dynamics (e.g., disrupting, restoring) associated with task-based cycles, we enable future MTS research to concurrently explore the dynamics associated with both teamwork and taskwork. Notably, understanding these task-based cycles is critically important for moving beyond the extant literature's almost exclusive focus on team and system-level processes and emergent states (Mathieu et al., 2018). Although these constructs are certainly important, understanding task-based cycles allows us to also build theory on the synchronization and orchestration of multiple tasks. Understanding how tasks are divided and integrated among members is an important concern for team performance (Marks , Mathieu, & Zaccaro 2001; Mathieu et al., 2017), especially in collectives that manage multiple tasks or activities (Ancona, Okhuysen, & Perlow, 2001). Heretofore, the processes associated with the division and integration of tasks have remained obscured, and only been speculated about using task taxonomies (e.g., McGrath, 1984), static structural frameworks (Hollenbeck, Beersma, & Schouten, 2012), or in the aggregate as coordination—although recent studies have made progress in this area (Ziegert, Knight, Resick, & Graham, 2020).

Our findings also advance understanding of the MTS–environment interface. When Mathieu and colleagues (2001) first articulated a framework of MTS effectiveness, they noted the importance of the environment and the lack of scholarly work on the relationship between the two. Two decades later, empirical work has yet to examine MTS functioning over time or its dynamic interface with a multifaceted operating environment. Our findings move beyond claims about the complexity and dynamism of the MTS–environment interface to show how tensions arise between the two. More specifically, they suggest that conceptualizing the environment as a single direct effect or moderator, as has been common in organizational research (Johns, 2018), is a simplification that neglects the potential for opposing pressures (here, dynamic complexity and dynamic challenge) and change over time. Instead of conceptualizing the MTS–environment interface as a monolithic downward influence of the environment on the MTS, it may be more accurate to conceptualize it as one of coevolution. Hence, scholars should adopt a more dynamic and multifaceted approach to the MTS–environment interface, carefully attending to its connections with MTS internal functioning. For example, considering the opposing environmental pressures might explain variance in performance previously attributed to poor team processes or ineffective decision-making.

Finally, our study offers implications for the leadership literature more broadly. We suggest that hierarchical, shared, and functional leadership may not be so discrete, but rather more fluid as shared and functional leadership may interrupt a hierarchical leadership structure. We explain how it may be possible to get the best of both more rigid (hierarchical) and more fluid (functional, shared) forms of leadership by moving between them, and when the double-edge sword of leadership task transitions makes the cost of doing so too high. By extension, this challenges researchers to move beyond discrete categories of leadership (e.g., hierarchical vs. shared, transformation vs. transactional) and consider the dynamic behaviors that contribute to the fluidity between them over time (McClean, Barnes, Courtright, & Johnson, 2019). Our study also provides a framework that enables the examination of transitions in other leadership structures, such as the rotation in rotated leadership or precisely how the transitions occur in other forms of shared leadership (e.g., distributed versus collective leadership) (Contractor et al., 2012).

### Practical Implications

Our study offers practical implications for leadership task transitions in MTSs as well. Paramedics often use the phrase "stay in your lane" to affirm the importance of doing the tasks designated for your assigned position and *only* your assigned position. We shift that consensus to suggest that *sometimes* it is important to briefly transition to unassigned tasks. Specifically, our findings offer three suggestions for paramedics, and other MTS members operating in complex and dynamic environments, for engaging in effective leadership task transitions. First, *be the stability in the storm*. Stated differently, when there is a lot going on (high cycle activity), stay in your position and maintain the expected flow of information. Second, *stay in your zone*; rather than staying in your lane (position), staying in your zone (area or sector) is consistently good advice. Our data suggest that individuals should not try to lead outside of their assigned sector (i.e., lateral transitions)—or anywhere they are not sure what is going on (e.g., where they have low sector awareness). Our data contain numerous instances of well-meaning paramedics engaging in leadership task transitions and directing others to do tasks that were already complete or out of sequence. Finally, it is important to *restore the cycle—quickly.* Stated simply, after conducting a leadership task transition it is important to restore the baseline functioning of the disrupted task-based cycle by reestablishing *each* of its elements instead of only a few (e.g., simply returning to prior tasks) or none.

### Future Directions

Our theory provides a launching point for many interesting avenues of research, in both similar and dissimilar contexts. To facilitate transferability (Lincoln & Guba, 1985; Shah & Corley, 2006), in this section we comment on the unique characteristics of our sample and context. We also call for future research to explore the limits of this transferability, as well as other novel avenues of research created by our theory.

***MTS environment.*** We collected data from paramedics actively engaging in emergency response. Thus, the insights generated by our study are likely most readily transferable to other emergency response settings. However, other organizations may also experience situations in which dynamic complexity and dynamic challenge both exist and shift over time, resulting in work demands unexpectedly changing and necessitating a quick response. Such situations may involve companies responding to a poor or unethical decision (e.g., executive misconduct, fraud), or simply a moment of carelessness or frustration (e.g., Twitter comments, clicking "reply all" instead of "reply") that require a quick response involving effective coordination between several teams within the organization (e.g., public relations, human resources, IT).

We hope future research will explore the boundary conditions of our theorizing by examining other environments. For example, in MTSs with slack resources operating in stable environments, leadership task transitions may occur so that leaders engage in role-modeling behaviors or provide growth opportunities for their members. Along similar lines, environments with low time pressure are likely to have low dynamic challenge, which may reduce the level of cycle activity, making successful restoration of task-based cycles easier to accomplish. Finally, we note that although many environments are generally categorized as more or less "dynamic," explaining the ebbs and flows (e.g., periods of stability vs. periods of rapid change) in each area (e.g., chaos in one sector yet relatively calm in another) may offer important insights.

***MTS structure.*** MTSs can vary is their leadership and system structures. In our MTS, task-based cycles were formed and maintained by a formal hierarchical structure and clearly defined tasks associated with each position. Although scholars have examined MTSs with a similar structure (e.g., Davison et al., 2012; Lanaj et al., 2013), it is by no means the only one that exists in MTSs. Indeed, MTSs could exist with a formally assigned flat structure with no formal leadership positions or even no formally assigned structure at all. This raises questions about how task-based cycles may be generated in informal leadership structures, and whether they are easier or more difficult to maintain—and change. In addition, future research should consider when and how rapid restoration of task-based cycles occurs with different individuals assuming the leadership position (i.e., leader role transitions) instead of only performing leader tasks. Along similar lines, future research could integrate theorizing on claiming and granting leadership (DeRue & Ashford, 2010) to better understand when and how engaging in a series of leadership tasks changes other members' expectations and thus becomes a leader role transition.

Second, our theory on internal MTS functioning can also transfer to other MTSs with different system structures. However, different structural factors may influence how easy it is to maintain the task-based cycles or the occurrence of leadership task transitions. For example, information transparency (i.e., low opacity), particularly when enabled by technology, has the potential to promote rapid acquisition of sector awareness, thus facilitating updating and cycle restoration. In contrast, in an MTS with high competency separation, there may be fewer leadership task transitions as members lack the competencies to perform other tasks—particularly in comparison to our MTS where members were trained for all tasks and the sector leader tasks were quite similar. We also note that our MTS had low *structural dynamism* (see Appendix A) (Luciano et al., 2018). While in our study this helped emphasize the phenomenon of interest, task-based cycle disruptions due to structural dynamism (e.g., changing goals, task requirements, interdependencies, membership) were limited. Future research should expand our theory to consider how different types of disruptions (e.g., endogenous vs. exogenous) influence MTS functioning, and how different types of disruptions may influence each other as well.

***Other potential research streams.*** As our theorizing incorporates two of the underresearched areas of

MTSs—individuals and taskwork—it creates the scaffolding to explore a host of new research questions. For example, future investigation of individual characteristics is warranted—especially those that may influence why certain individuals choose to engage in leadership task transitions. Even in a context such as ours, with strong formal positions and established protocols, our data suggest that leadership task transitions are not rare occurrences. In our study, at least one person was engaged in a task not designated for their position 80.1% of the time somewhere in the MTS, and 58.4% of the time within each particular sector. This suggests there is important variance to explore in a variety of contexts.

Future research should also explore questions related to learning and adaptability in MTSs. Our system members had some general familiarity with one another from attending class together one day per week, but no shared experience responding to mass-casualty incidents (or coordinating to complete larger tasks). In addition, they were reassigned to different positions for each scenario, curtailing position-specific learning and rhythm development. We speculate that teams with no prior shared experiences, especially in flatter and more fluid MTSs, may struggle to restore ill-defined cycles. Alternatively, MTSs with high shared experiences, and entrained rhythms in their task-based cycles, may struggle to adapt to unexpected shifts in environmental pressures. Indeed, delving into the task-based cycles in MTSs in multiple contexts and unlocking when and how multiple individuals may fluidly transition between different tasks while maintaining the task-based cycles, is likely to have profound insights for the underresearched areas of MTS learning and adaptability.

***Other organizational forms.*** Future research is also needed to confirm which elements of our findings are transferable to other organizational forms, such as teams and organizations. We speculate that leadership task transitions may more frequently have a positive impact on effectiveness in teams than MTSs. First, in a standalone team, a single formal leader position can negate the potential for lateral leadership tasks to occur and multiple cycles to be disrupted. If the team is colocated (as opposed to geographically distributed) and working on a collective task (as opposed to multiple cooccurring objectives, in our case patients), cycle restoration will likely be easier (e.g., updating to gain cycle awareness). However, as teams are increasingly distributed (e.g., virtual teams), fluid (e.g., teaming), or have multiple overlapping memberships, there is increased potential for standalone teams to experience similar challenges. Therefore, future research should consider how the distribution of members influences task-based cycle restoration in both teams and MTSs, how the quantity of formal leaders in each team influences the phenomenon (Dust & Ziegert, 2016), and how task-based cycles may be relatively harder or easier to manage in different organizational forms.

Turning to organizations, they also come in a variety of forms that may influence transferability (e.g., team-based organizations, matrix organizations). In general, organizations have a much lower level of interdependence between their component collectives (e.g., units) compared to MTSs, although task forces and subassemblies within organization often come closer (Mathieu et al., 2001; Zaccaro et al., 2012). We speculate that this lower level of interdependence discourages lateral leadership task transitions, as coordination is conducted through higher levels of the hierarchy, although the theorizing about vertical leadership task transitions is likely to apply. An organizational form with great promise for generating new insights is the matrix organization. Our emergency response MTS, and many others, have a "unity of command and scalar chains of authority" (Joyce, 1986: 536) not present in matrix organizations. Thus, our theorizing offers concepts and verbiage to facilitate exploration of related phenomena in matrix organizations, but does not speak to the dual leader structure.

## CONCLUSION

MTSs are utilized to address challenges beyond the capacity of single teams—often with life-or-death consequences. In complex and dynamic operating environments, individuals struggle to cope with opposing environmental pressures. Leadership task transitions help an MTS respond to changes in the environment. However, they are a double-edged sword because even as they help alleviate the dominant environmental pressure they inherently disrupt one or more task-based cycles that enable effective MTS internal functioning. Hence, leadership task transitions should be wielded with caution, especially when it would impact multiple areas (multiple cycles involved) or there is a lot going on (high level of cycle activity).

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## APPENDIX A
## KEY FACTORS THAT INFLUENCE MULTITEAM SYSTEM (MTS) FUNCTIONING (FROM LUCIANO ET AL., 2018)

| Factor | Description of the study MTS |
|---|---|
| MTS Structural Features—Differentiation | |
| Goal Discordancy | Low–Medium: Sectors have different tasks but similar goal priorities and compatible goals as each sector clearly contributes to the superordinate goal of saving lives and limbs. One potential source of discordancy is that if the sector chooses to shift their goal priorities to focus on efficiency goals *over* quality of patient care related goals it adversely impacts the sequentially later sectors. |
| Competency Separation | Low: All sectors are comprised of paramedics with similar general training (knowledge and capabilities). Although each sector has different tasks, any paramedic is capable of performing any or all of those tasks and could be assigned to any sector. |
| Norm Diversity | Low: Sectors are comprised of paramedics who are governed by similar policies, professional norms, and have been trained on the same mass-casualty incident protocols, creating similar expectations. |
| Work Process Dissonance | Medium: Work processes are intensively interdependent within sector and sequentially interdependent between sectors. Overall, the sector processes are relatively harmonious as each clearly builds on the previous. The workflow for each task (patient) is sequential (flowing from Triage to Treatment to Transport); however, they may occur concurrently. For example, the Triage sector may still be extracting patients while the Transport sector is loading other patients onto ambulances. |
| Information Opacity | Medium: Information about other sector activities can be obtained and interpreted. Notably, as the sectors are physically separated and there is no automatic monitoring system, the information is not readily available and has to be sought out. |
| MTS Structural Features—Dynamism | |
| Change in Goal Hierarchy | Low–Medium: The overarching goal hierarchy remains fairly stable throughout, although the salience of different goals may wane as they are accomplished. For example, in the first few minutes of the incident the focus is on finding and rapidly assessing patients, after which the focus shifts to stabilizing and transporting patients, in order of criticality, as quickly as possible. |
| Uncertainty of Task Requirements | Low–Medium: As there are existing mass casualty incident protocols there is a sense of the potential requirements to meet the MTS goals. However, there is uncertainty surrounding the specifics of the task (e.g., type of incident; patient location, quantity, and injuries). |
| Fluidity of System Structural Configuration | Low–Medium: Linkages among the sectors are stable as the patients flow through the MTS in a consistent way. However, the importance of each sector shifts to follow the presence of critically injured patients. |
| Fluidity of System Composition | Low–Medium: System membership is stable throughout (i.e., the same 13 paramedics). However, sector membership often changes a few times per incident. For example, when Triage tasks are complete team members are generally reassigned to the Treatment or Transport sectors. |
| Diversion of Attention | Low: Sectors are members of only one system at a time. The MTS is formed to respond to the incident (e.g., motor vehicle accident) and disbanded when the incident is complete. No external tasks are requested during that time. |