

**UPDATING AS PART OF EVERYDAY WORK: AN INTERACTIONAL
PERSPECTIVE**

by

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This dissertation is dedicated to the people who, in turn, dedicate their lives to making the care that patients receive safer and more reliable.

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Abstract

Despite the importance of updating, which I define as a process in which actors revisit and potentially revise their current understanding of and response to an evolving situation, we know relatively little about what updating looks like and when and how updating occurs. To address this gap in the literature, I use an inductive approach to study how emergency department (ED) healthcare providers make sense of a patient's symptoms and update their understanding as that patient's symptoms change over time. I study updating of in two research contexts – the field (the ED) and the medical simulation lab – and draw on qualitative data consisting of non-participant observations and archival video footage to develop theory around how updating is accomplished.

In the ED, I find that updating is indeed part of everyday work but is also a more problematic process than is often suggested. Healthcare providers recognize the challenges associated with updating and engage in proactive behaviors – including revisiting the patient's trajectory of care, surfacing expectations, and communicating richly – to facilitate updating. My data suggest that a specific type of social interaction – bids for attention – helps to shape updating. I develop theory around bids for attention and responses to those bids, which I then elaborate and refine in my lab study.

In the lab, I compare and contrast the performance of 24 teams of ED healthcare providers participating in simulation training. I find that effective updating occurs the majority (67%) of the time but with significant variation in performance. My lab study confirms that social interactions are important for updating but also shows that updating can emerge as healthcare providers interact with the physical or cognitive environment. I discover that updating can be accomplished through a variety of pathways, ranging from an individual acting alone to collective action. Last, I identify important qualitative differences in how high and low-performing teams interact with each other and highlight the need for a more nuanced examination of the building blocks of social interaction (double-interacts) to gain additional insight into how more or less effective updating is accomplished.

Chapter 1

Introduction

Organizations today face environments that are ever more competitive, dynamic, and uncertain (D'Aveni, 1994: 70-71; Eisenhardt, 1989b; Weick, Sutcliffe, & Obstfeld, 1999). As a result, work within organizations is becoming increasingly complex, fast-paced, and interdependent (Griffin, Neal, & Parker, 2007; Pulakos, Arad, Donovan, & Plamondon, 2000). Successful performance often depends on the ability of individuals to update and revise their understanding of evolving situations in a timely manner in order to prevent or minimize error (Weick, Sutcliffe, & Obstfeld, 2005). For example, traders need to update their understanding of a volatile financial market and take appropriate action in order to avoid significant losses for their clients, and, similarly, product managers need to update their understanding of a changing product market in order to avoid launching products that fail to meet customers' needs. However, despite the importance of updating, we know that it is difficult for people to change their original understanding of a situation, even in the face of mounting evidence that their understanding is mistaken (e.g., Klayman, 1995; Rudolph, 2003; Staw & Ross, 1987).

I define *updating* as a process through which actors revisit and potentially revise their current understanding of and response to an evolving situation. There are two main gaps in the literature related to updating. First, while previous research has identified numerous barriers to updating (e.g., Nisbett & Ross, 1980; Staw & Ross, 1987), little is known about how individuals organize to overcome these barriers. Second, the research

related to how updating is accomplished paints updating as a predominantly individual, cognitive, and acontextual process, which overlooks that updating cannot be isolated from the situational particulars of the context in which it occurs. My dissertation aims to fill these gaps by develop a rich understanding of updating, paying special attention to the situationally embedded nature of updating. I study how updating is accomplished by individuals engaged in complex interdependent work in order to answer my research questions: “What does updating look like?” and “When and how does updating occur?” Understanding how individuals organize – or “assemble ongoing interdependent actions into sensible sequences that generate sensible outcomes” (Weick, 1979: 3) – to overcome barriers to updating is particularly relevant for complex and interdependent work, where single actors are not able to accomplish their work by themselves.

To answer my research questions, I conduct two studies: the first study develops a theory of updating as it occurs “in the wild” and the second study elaborates and refines my theory of updating. For both studies, I study updating in a healthcare context, where effective updating is critical but frequently does not occur. Healthcare providers must be able to update their understanding of a patient’s medical condition in order to avoid errors in diagnosis, which can cause significant harm to patients (Kuhn, 2002). Despite the importance of effective updating, diagnostic errors commonly occur and are the second leading cause of adverse events in hospitals (Leape et al., 1991).

The first study is set in the Children’s Hospital emergency department (ED) and the second study is set in the Children’s Hospital medical simulation lab. The first study uses data from non-participant observations and archival video footage of patient care in the critical care area of the Children’s Hospital ED. Observing ED healthcare providers

as they update their understanding of a patient's changing medical condition provides insight into different patterns of updating – or what updating looks like – and the conditions that promote updating – or when and how updating occurs. The second study uses data from archival video footage from the simulation lab. In the simulation lab, teams of healthcare providers – including physicians, mid-level providers, and nurses – in the Children’s Hospital medical simulation lab care for simulated patients in crisis. The ED observations allow me to generate a rich and nuanced understanding of the process of updating and the conditions that promote updating and the simulation lab observations allow me to elaborate and refine my understanding of updating. In particular, the simulation lab setting enables me to link conditions that promote updating with performance outcomes. Theoretically, my findings will contribute to a diverse set of literatures including adaptation, sensemaking, and the coordination of interdependent work. Practically, my findings identify factors that enable healthcare professionals to detect and correct medical error.

In this chapter, I have emphasized the importance of updating. I have briefly outlined the purpose of this dissertation and how I plan to accomplish my research. In Chapter 2, I review the current literature as it relates to updating to provide some background for my study. In Chapter 3, I introduce the research design and methods that I use in my dissertation. In Chapter 4, I present the findings from my field study and, in Chapter 5, I present the findings from my lab study. I end with Chapter 6, which discusses the contributions and implications of my findings.

Chapter 2

Literature Review

My literature review is organized in three sections. First, I further clarify what I mean by the term updating. Second, I make the case for why the study of updating is important from both a theoretical and practical perspective. Third, I outline what is known about updating, highlighting that there are two largely opposing perspectives within the organizational literature: on the one hand, literature related to cognition and commitment suggests that the barriers to updating are often insurmountable; on the other hand, literature related to the study of complex and dynamic organizations assumes that updating can and does occur as part of everyday work.

Defining Terms: What Updating Is and Is Not

As I defined it in the previous chapter, updating is *a process through which actors revisit and potentially revise their current understanding of and response to an evolving situation*. I want to unpack the components of that definition. First, I want to highlight the *processual* aspect of updating. Second, I use the word *actors* in the definition because updating is a process that can conceivably occur at many levels of analysis. In my dissertation, I focus on the updating process of individuals working in groups but, for example, updating could also be studied at the purely individual level, the purely social level, or the organizational level.

Third, during updating, actors *revisit and potentially revise* their current understanding of and response to a situation. Updating is a process of re-calibration, of

re-evaluation, and of re-activating sensemaking. Phrased differently, updating is not naive sensemaking but instead the process of making sense again of a situation that the actor has already made sense of. If sensemaking is the process of asking and answering the question, “What’s the story?” and “Now what?” (Weick et al., 2005), then updating is the process of asking and answering the question, “Does the sense that I have made still make sense?” Additionally, updating does not require a change in understanding, for it may be that the actor’s current understanding of a situation is still the most plausible explanation. In updating, it is the revisiting and the potential for revising that are important. As a final note, when examining the conditions that promote updating, it is also important to keep in mind that the conditions that influence revisiting may differ from those that influence revising.

While updating can be triggered by unconscious processes or external events, I am most interested in what happens after updating has been triggered. The idea that cognition and action have both automatic and active components is well-established (see Bargh & Chartrand, 1999; Bargh & Ferguson, 2000 for review). Louis and Sutton (1991) describe the transition from automatic thinking (which they call “habits of mind”) to active thinking as “switching cognitive gears.” I focus on the cognitive and conscious aspects of updating (i.e. with the use of the word ‘understanding’ in the definition) because I want to emphasize that updating represents a transition from more automatic thinking to more active thinking.

It may seem, initially, that updating is not meaningfully distinct from the larger construct of sensemaking. Sensemaking occurs when “people organize to make sense of equivocal inputs and enact this sense back into the world to make that world more

orderly” (Weick et al., 2005: 410). Sensemaking combines thinking and action: “How do I know what I think until I see what I say?” is a question that captures the iterative relationship between thinking and action (Weick, 1995) and draws attention to the retrospective nature of sensemaking. Put another way, people act their way into knowing rather than knowing first and then acting. Sensemaking involves constructing a plausible story about events and acting to test that story. It is important to note that sensemaking is not linear and, therefore, constructing a plausible story may occur as a result of acting rather than as an impetus for action.

Sensemaking is theorized to be an adaptive process without a discrete beginning or ending (Weick, 1995: 43). However, because sensemaking is effortful, it is reasonable to assume that the intensity of sensemaking may ebb and flow, depending on the demands of the environment, a particular task, and the skill of the sensemaker. In fact, sensemaking scholars describe various occasions for sensemaking or triggers for sensemaking, such as surprise (Louis, 1980), environmental jolts (Meyer, 1982), or cosmology episodes (Weick, 1993). The assumption that sensemaking is ongoing rests on the premise that sensemakers are able to continue to make sense again once they have made sense in the first place.

However, individuals are not dispassionate or impartial sensemakers. Rather, individuals become invested in their own understanding of a situation: they act to bolster their interpretation of events and discredit alternate interpretations (Klayman, 1995; Nickerson, 1998) and they have trouble noticing cues in the environment that would suggest that a situation has changed or that their understanding is mistaken despite mounting evidence to the contrary (Davies, 1997; Rudolph, 2003; Staw & Ross, 1989).

First notions about what is happening are difficult to change. With rare exceptions (Weick, 1993), initial sensemaking may be surprisingly – even inappropriately – enduring. Nisbett and Ross find that, “People tend to persevere in their beliefs well beyond the point at which logical and evidential considerations can sustain them” (1980: 192). Therefore, the process of updating seems worthy of specific consideration as the conditions under which updating is more or less likely to occur are underspecified.

The fourth part of the definition of updating that I want to emphasize is the phrase, *current understanding of and response to*. Cognition and action are reciprocally and inextricably linked. I use the phrase “*understanding of*” because updating is, from an epistemological standpoint, a constructionist not objectivist construct. That is to say, in updating meaning is constructed not discovered (Crotty, 1998). Many organizational scholars pay credence to the notion that individuals socially construct their reality (Berger & Luckmann, 1966). Social constructionist scholars believe that an individual’s understanding of the world is an interpretation, which can be influenced not only by the individual but also by others and by the world itself. I use the phrase “*response to*” in order to highlight that social constructionists also believe that individuals have an active role in shaping their environment just as the individual’s environment has an active role in shaping them (Giddens, 1984; Sewell, 1992).

Likewise, I use the word *current* to highlight that understandings themselves change over time. The actor’s current understanding may range from a vague notion of “I don’t know what is going on here but something is wrong” to a more developed hypothesis such as “I think that x is the cause of the patient’s symptoms.” Updating can result in the realization that an actor’s current understanding is no longer appropriate or

plausible, either because the situation has changed or because their previous understanding had been in error (i.e. they had been on the wrong path and need to modify a course of action). In this way, updating can be seen as closely linked to error detection and recovery. Actions can become mistaken rather than begin as mistakes (Paget, 1988). When individuals update, they are able to detect and mitigate (or even correct) errors early in their unfolding by noticing, interpreting, and responding to cues that their current understanding may not reflect the current situation.

Fifth, I include the phrase *evolving situation* to emphasize that the context for sensemaking is itself changing over time. If we take the idea of recursive interaction between the environment and the actor seriously, then the context or environment for sensemaking is constantly changing and updating becomes a necessary adaptive capability. Classically, organizational scholars use the term environment to refer to that which is outside of the boundary of the organization. Yet, environment is a relative term – what environment means depends on the level of analysis. Rather than get entangled in various definitions of environment, I conceive of the environment more broadly; *Merriam-Webster's Collegiate Dictionary* (2002) defines environment as “the circumstances, objects, or conditions by which one is surrounded.” The relevant environment for my dissertation research, given that I am interested in how individuals engaged in complex, fast-paced, and interdependent work update their understanding of an evolving situation, will be the circumstances, objects, or conditions that surround individuals at work or – more concretely – the things that individuals can hear and see and touch, the people with whom they interact, the tasks they must accomplish, etc.

The phrase updating is not new in the organizational literature. There are two previous usages of the term updating that I want to incorporate into my discussion of updating. First, the construct of *mindful updating* (Weick & Sutcliffe, 2001, in particular see pp. 44-46 and pp. 118-119) or *ongoing updating* (Weick et al., 2005, see pp. 414 and 418) appears in the sensemaking literature. But, while the idea of updating is implicit in sensemaking, updating is rarely defined or empirically studied. For example, Weick et al. (2005: 414) include ongoing updating as part of their model of sensemaking (see Figure 2.1) although updating is not defined. Note that in Figure 2.1 updating is located at the interface between the environment (ecological change) and the actor (enactment).

Weick and Sutcliffe write,

...mindfulness is essentially a preoccupation with updating. ...The power of a mindful orientation is that it redirects attention from the expected to the irrelevant, from the confirming to the disconfirming, from the pleasant to the unpleasant, from the more certain to the less certain, from the explicit to the implicit, from the factual to the probably, and from the consensual to the contested” (2001: 44).

They suggest that there are three main ways in which updating occurs: “Whenever people update their understanding of what is happening, they essentially rework the ways they label and categorize what they see. They do at least three things: reexamine discarded information, monitor how categories affect expectations, and remove dated distinctions” (Weick & Sutcliffe, 2001: 44). While updating is seen as desirable and even necessary, it is less clear how updating is actually triggered and accomplished. My definition of updating is in keeping with the idea that updating is part of sensemaking but extends previous research by emphasizing that updating represents a reactivation of sensemaking and acknowledges that updating may be more difficult to accomplish than is usually theorized in the sensemaking literature.

Second, the construct of *Bayesian updating* is discussed in the literature on decision making (Nelson, 2005; O'Flaherty & Komaki, 1992). Bayes' rule or theorem, which relates the conditional and marginal probability distributions of random variables and can be used to infer or update the degree of belief in light of new information (i.e. based on experience or *a posteriori*) (Joyce, 2003). Because definitions of terms can be further refined by explicitly stating not only what a term includes but also what it does not include, I want to be clear that I am not using updating in a Bayesian sense.

There are several important distinctions between Bayesian updating and my use of the term updating. To begin, Bayesian updating is a prospective process and is used to predict how people will act in the future. In contrast, updating, as I define it, is part of a retrospective sensemaking process and, therefore, used to understand how people are acting or have acted. Next, Bayesian updating involves rational calculus i.e. presumes that individuals calculate probabilities and act on them. In contrast, updating as part of sensemaking does not necessarily involve estimations of risk or probability. Last, Bayesian updating requires repeated trials and learning. Whereas Bayesian updating assumes learning, updating may or may not result in learning. The repeated trials component of Bayesian updating implies a more static setting i.e. for the trials to be repeated the basic framework needs to be held constant. However, I am interested in updating in dynamic settings where the framework itself is changing.

Last, I want to sketch out how my research on updating differs from Rudolph's (2003) research on *fixation error*. There are many similarities between my research and Rudolph's research and the constructs of updating and fixation error are in some ways two sides of the same coin. Whereas I define updating as an adaptive process in which

actors revisit and potentially revise their understanding of and response to an evolving situation, Rudolph defines fixation error as “the process of clinging to a single presumed diagnosis despite mounting cues that one is on the wrong track” (2003: v). Fixation error can be thought of as a failure of updating (in some cases a failure to revisit the original diagnosis at all and in other cases a failure to revise the diagnosis despite revisiting it). Our work differs on the two dimensions that I have identified as gaps in the literature around updating. Whereas Rudolph studies the factors that cause healthcare providers to persist with an erroneous diagnosis, I study the conditions that enable healthcare providers to update their understanding. And whereas Rudolph’s research is focused on the individual, on cognition, and on fixation error in the laboratory setting, my research has a broader focus and examines how individuals organize to update their understanding “in the wild” as they perform their complex interdependent everyday work. Having defined updating and distinguished it from related concepts, I now turn to a discussion of why updating is important.

The Case for Studying Updating

Updating is a fundamental but poorly understood aspect of organizing. Organizational life is dynamic and requires actors to detect and respond to changes both within and outside of the organization (Weick, 1979). As work becomes more complex, fast-paced, and interdependent (Eisenhardt, 1989b; Eisenhardt & Martin, 2000; Howard, 1995), the ability for individuals to update and revise their understanding of evolving situations in a timely manner is necessary in order to prevent or minimize error (Griffin et al., 2007; Pulakos et al., 2000; Weick et al., 2005). Yet, despite the importance of updating, we know very little about how updating occurs.

There is a tension in the organizational literature: on the one hand, there is a significant body of research – ranging from literature on the limitations of cognition (March & Simon, 1958; Tversky & Kahneman, 1974) to literatures on commitment (Salancik, 1977a; Staw & Ross, 1987) to literatures on error (Perrow, 1986; Reason, 1990; Snook, 2000; Vaughan, 1996) – that suggests that updating is very difficult to accomplish. In this research, there is surprisingly little investigation of how individuals might organize to overcome these barriers to updating. On the other hand, there are streams of research – such as sensemaking (Weick, 1995) or high reliability or resilient organizing (Roberts, 1990; Sutcliffe & Vogus, 2003; Weick & Roberts, 1993; Weick & Sutcliffe, 2007; Wreathall, 2006), coordination (Bechky, 2006; Faraj & Xiao, 2006; Hargadon & Bechky, 2006; Klein, Ziegert, Knight, & Yan, 2006), and knowledge-in-practice (Brown & Duguid, 1996; Orlikowski, 2002) – that implicitly assume that updating can and does occur as part of everyday work.

The different perspectives on updating reveal two important gaps in the literature: first, little is known about how updating is accomplished and, second, the literature that does exist primarily frames updating as an individual, cognitive, and acontextual process, which overlooks that updating should not be isolated from the situational particulars of the context in which it occurs. By studying updating in the context of complex and interdependent work and asking process and mechanisms questions – i.e. “What does updating look like” and “When and how does updating occur?” – I aim to fill these gaps. Building theory related to process (Mohr, 1982) requires studying events as they unfold over time, discerning what conditions are necessary in order for a certain outcome to occur, and being mindful of interdependence. Asking mechanisms questions (Elster,

1998; Hedstrom & Swedberg, 1998) provides insight into understanding boundary conditions (Anderson et al., 2006) and I am interested in the boundary conditions of updating, such as: What patterns of updating are there? When does updating include revisiting and revising? (vs. just revisiting), How does updating occur as part of everyday work?, When does updating occurs?, and What conditions make updating more or less likely to occur?.

Updating and the Organizational Literature

As previously mentioned, the literature related to updating falls into two broad and largely opposing camps: updating is difficult vs. updating is part of everyday work. I begin by reviewing a wide range of relevant literatures that suggests that updating is difficult, if not impossible, to accomplish.

“Updating is difficult” perspective

The human understanding when it has once adopted an opinion draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises, or else by some distinction sets aside and rejects, in order that by this great and pernicious predetermination the authority of its former conclusion may remain inviolate.

(Francis Bacon cited in Nisbett & Ross, 1980: 167)

Many different streams of research suggest that updating is difficult. First impressions or theories are “sticky” or difficult to change. For example, the *belief persistence* literature suggests that first impressions (Asch, 1946) or initial beliefs tend to persist (Tutin, 1993). The *social theory persistence* literature suggests that individuals develop social theories – or beliefs about “how and in what way variables in the social environment are related” (Anderson & Sechler, 1986: 24) as a way to organize knowledge, explain events, and make future predictions (see Anderson & Lindsay, 1998

for review). In fact, social theories can persist even when the evidence to support them is unequivocally discredited (Davies, 1997; Schul & Burnstein, 1985). The *explanations* literature, which is closely intertwined with the *social theory* literature, is similar in many ways to the sensemaking perspective. Although used often in discussion of complex decisions (such as jury deliberation), the explanation literature considers how individuals create meaning and understanding from often confusing and contradictory pieces of information (e.g., Pennington & Hastie, 1992). Explanations, like social theories, “provide a sense of mechanism” (Keil, 2006: 228) but also “reflect an attempt to communicate an understanding” (Keil, 2006: 229).

Explanations can seem innocuous but they are unexpectedly powerful: the act of creating an explanation influences future cognition and future actions (Koehler, 1991). For example, Anderson, Lepper and Ross (1980) found that merely asking subjects to create an explanation – even when the subjects were then told that the evidence on which they’d based their explanation was completely false – was sufficient to cause the subject’s social theories to persist despite the evidential discrediting. Why are explanations so powerful? One hypothesis is that once a particular perspective or frame has been created, it limits what else can be noticed. Koehler writes that after an explanation has been developed, “...a certain inertia sets in, which makes it more difficult to consider alternative hypotheses impartially. In other words, the initial impression seems to persist despite the person’s efforts to ignore it while trying to give fair consideration to an alternative view” (1991: 503). This mechanism is in keeping with prior work on other types of cognitive biases, such as anchoring (Kahneman, Slovic, & Tversky, 1982).

First impressions, interpretations, or theories can lead to distortions in information processing that contribute to difficulty updating. It is often challenging for individuals to find and process new information that might alter their first impressions or beliefs. There are many cognitive biases that have been described that contribute to difficulty updating, among them the *confirmation bias*, in which individuals privilege information that confirms their hypothesis and disregard information that disconfirms their hypothesis. Klayman describes confirmation bias as the “general tendency for people to believe too much in their favored hypothesis” (1995: 385). Confirmation bias is thought to be a collection of related phenomenon, perhaps with varying mechanisms, that share the common themes of a strong bias toward thinking about positive information rather than negative information (i.e. people are more likely to test for features that support rather than disconfirm their hypothesis) and a failure to consider alternate hypotheses (Klayman, 1995; Nickerson, 1998). Because confirmation bias is a bias of how people collect and consider new information, confirmation bias may exert a stronger influence on the revisiting aspect of updating rather than the revising aspect. A possible implication of this research on confirmation bias for updating is that it is important to pay attention to the range of hypotheses that are developed, the type of information that is sought out to evaluate the hypotheses, and the strategies that individuals use to overcome the confirmation bias.

Once impressions are acted upon, it becomes even more difficult for individuals to alter their interpretation of a situation. Actions start people on trajectories of behavior and cognition that are difficult to change. Actions – particularly if visible to others, difficult to undo and chosen freely – constrain future actions and beliefs (Kline & Peters,

1991; Salancik, 1977a). Actions influence not only the sensemaking of the actor but also others who observe the action (Weick, 1995: 12). Salancik writes,

The power of commitment in shaping attitudes stems from the fact that individuals adjust their attitudes to fit the situations to which they are committed. It is what makes the behavior self-sustaining. You act. You believe that your action was valuable, worthwhile, and desirable. You act again, renewing the belief. In time, without realizing it, you have made a myth; your sense of veracity and value has been merged into a pattern of action. (1977b: 70-71).

Thus, an important implication of the behavioral commitment literature for updating is that acting on interpretations can make it even more difficult for an individual to consider alternate hypotheses and potentially revise their working understanding of a situation. As such, it is important to pay attention to how trajectories of action and cognition unfold and, more specifically, how various characteristics of action (i.e. how public, revocable, or volitional) influence that trajectory, as certain types of action may be more likely to constrain subsequent cognition and action.

The literature on *escalation of commitment* (Brockner, 1992; Staw, 1976; Staw & Ross, 1987; Whyte, 1986) extends the research on behavioral commitment and studies extreme cases of action constraining future behavior and cognition in which actors continue to devote resources to a failing course of action. The concept of escalation of commitment was introduced by Staw (1976) to explain the counterintuitive experimental finding that individuals participating in a simulated business case allocated more research & development funds to failing business divisions than successful business divisions, particularly if they felt responsible for the failure of the division. The behavior described by escalation of commitment is captured in the aphorism, “throwing good money after bad.” While the term escalation of commitment initially referred to the theory developed by Staw (1976), it now serves as an umbrella term for related concepts that all center

around individuals committed to failing courses of action. These related concepts include the “sunk cost effects” (Arkes and Blumer, 1985), “too much invested to quit” (Teger, 1980), and entrapment (Brockner & Rubin, 1985).

The literature on escalation of commitment both highlights that updating is difficult and suggests mechanisms that should be considered in the context of updating, including the need to justify actions to oneself (Brockner, 1992; Staw & Ross, 1989) and how alternative choices are framed (Whyte, 1986), however, this literature focuses almost exclusively on the factors that promote escalation rather than factors that might minimize or mitigate escalation. The few articles that examine de-escalation of commitment (Drummond, 1995; Garland, Sandefur, & Rogers, 1990; Heng, Tan, & Wei, 2003; Pan, Pan, & Flynn, 2004; Simonson & Staw, 1992) treat de-escalation of commitment as the opposite of escalation, however, it may be that the factors that inhibit updating are NOT the opposite of those that promote updating.

Despite the wide variety of theories explaining escalation and de-escalation of commitment, there are some common findings, which can be summarized as follows: to increase the likelihood of escalation of commitment (and perhaps decrease the likelihood of updating¹), pick a novice (Garland et al., 1990) who is highly confident and has a high need to achieve success (Moon, 2001; Whyte, Saks, & Hook, 1997); place them in a threatening environment (lacking psychological safety or tolerance for failure) (Edmondson, 1999; Pan et al., 2004); ensure that they feel the need to justify their behavior to themselves (Salancik, 1977a; Staw, 1976) and others (Brockner, Rubin, & Lang, 1981; Fox & Staw, 1979), emphasize that they are personally responsible for any

¹ As an aside, you will also note that this description of a recipe for escalation of commitment is very similar to how healthcare providers, particularly physicians, are trained.

failure (Brockner, 1992; Staw, 1976; Staw, Sandelands, & Dutton, 1981); leave them on their own with little to no monitoring of their behavior (Drummond, 1995; Keil & Robey, 1999; Simonson & Staw, 1992); and make the situation highly ambiguous so that it is difficult for them to determine the cost of their continued commitment (Garland et al., 1990; Staw & Ross, 1987). The implication of the escalation of commitment literature for studying updating is that it is important to pay attention to expertise, perceived responsibility, social context, and feedback as they may influence when updating is more and less likely to occur.

Taken together, the research on belief persistence, social theory persistence, explanations, cognitive biases, behavioral commitment, and escalation or de-escalation of commitment suggests (1) that updating is difficult and (2) that it may take relatively little in the way of initial cognition or initial action to create a context where individuals become committed to a course of action. I want to be careful about the conclusions that I draw from these varied streams of research as I certainly do not want to overstate the findings or create a “straw man.” While updating may be difficult, common sense and an entirely different set of research within the organizational literature emphasizes that updating must be possible as part of everyday work, otherwise individuals would not be able to successfully accomplish their work and errors would be omnipresent. I now turn to an examination of various streams of research that assume that updating occurs as part of everyday work.

“Updating occurs as part of everyday work” perspective

In every waking moment, the complete balance of the organism and its environment is constantly interfered with and as constantly restored. Life is interruptions and recoveries... At these moments of a shifting in activity, conscious feeling and thought arise and are accentuated.

(John Dewey, 1922/2002: 178-179).

Dewey's (1922/2002) quote, which speaks of recovery and restoration as commonplace "in every waking moment," is a sharp contrast to the Francis Bacon quote I used to begin the previous section of this dissertation. Dewey writes about life being "interruptions and recoveries," and I think about updating as a recovery. Even though there is significant evidence that updating is difficult, we also know that updating must and does occur as part of everyday work. Individuals engaged in complex and interdependent work must be able to update their understanding of an evolving situation in order to successfully accomplish their work and detect and correct errors early in their unfolding.

The need for updating is most obvious in extreme contexts, such as aircraft carriers, nuclear power plants, or wildland fire crews, where failures of updating can result in catastrophe. For example, on the dynamic environment of the flight deck on an aircraft carrier, the aviator and many other individuals, including air traffic controllers, landing signal officers, and air operations staff, must all be able to organize to update their understanding in order for the aviator to safely take off and land their plane (Weick & Roberts, 1993: 362). In a large wildland fire, a variety of professionals from firefighters (coming from all around the country) to helicopter pilots to those expert in operating earth moving equipment, such as bulldozers, must all be able to organize to update their understanding of the evolving fire in order to put the fire out and to avoid, as much as possible, loss of property and loss of life (Bigley & Roberts, 2001).

In addition, updating must also occur in less extreme contexts, particularly those contexts where innovation is required and where work is fast-paced. Employees within

IPO software firms must be able to organize to update their understanding of the financial markets in which they operate in order to maximize profit (Vogus & Welbourne, 2003). Employees in utility companies must be able to organize to update their understanding of continually fluctuating demand in order to avoid brownouts or blackouts (Schulman, Roe, van Eeten, & de Bruijne, 2004). Likewise, entrepreneurs must be able to quickly update their understanding of changing market conditions, including what their competitors are doing and what their investor's concerns are, in order for their business to survive (Perlow, Okhuysen, & Repenning, 2002).

If we take seriously the idea that updating must and does occur as part of everyday work, then it is essential to understand when and how updating occurs. As mentioned previously, there are several streams of research – such as sensemaking (Weick, 1995) or high reliability or resilient organizing (Roberts, 1990; Sutcliffe & Vogus, 2003; Weick & Roberts, 1993; Weick & Sutcliffe, 2007; Wreathall, 2006), coordination (Bechky, 2006; Faraj & Xiao, 2006; Hargadon & Bechky, 2006; Klein et al., 2006), and knowledge-in-practice (Brown & Duguid, 1996; Orlikowski, 2002) – that implicitly assume that updating can and does occur as part of everyday work. Although these literatures assume that updating occurs, the mechanisms through which updating is accomplished in interdependent work remain under-specified. Although updating-like concepts are discussed in these literatures – for example, the importance of doubt and discrediting in sensemaking (Weick, 1979: 221-228) – a rich description of patterns of updating and a more detailed understanding of the interactional and contextual conditions that promote updating is largely absent.

A variety of different streams of research – taken together – suggest what topics are important to keep in mind when studying updating. For example, noticing that there is something to update about is a necessary precursor to updating. The literature on how changes in the environment become salient for actors within organizations encompasses a wide range of concepts including *surprise and sensemaking* (Louis, 1980), *perceptual filters* (Starbuck & Milliken, 1988), *problem sensing* (Kiesler & Sproull, 1982), *problem recognition* (Cowan, 1986), and *problem detection* (Klein, Pliske, Crandall, & Woods, 2005). Three dominant themes emerge from research on how changes become salient: first, whether a change is noticed depends both on the nature of the stimulus and the state of the perceiver, second, violated expectations prompt noticing and third, how changes are labeled shapes subsequent sensemaking. I expand on these points below.

First, noticing depends on the both the nature of the change (stimulus) in the environment and the state of the person observing the stimulus (perceiver) because the perceiver cannot be separated from their environment (i.e. the perceiver influences the environment just as the environment influences the perceiver). Certain stimuli seem to be more easily noticed than others (Kiesler & Sproull, 1982; Starbuck & Milliken, 1988), particularly stimuli that are personally relevant, that fit within the perceiver’s schema or framework for understanding the situation, and that deviate from acceptable parameters or prior expectations. However, it is not the stimulus alone that matters: Starbuck and Milliken (1988) point out that, “The stimuli that one executive receives may be precisely the same stimuli that another executive filters out,” emphasizing the perceiver also plays a role in whether stimuli are noticed. For instance, experts may be more likely to notice changes that novices miss (e.g., Benner, Hooper-Kyriakidis, & Stannard, 1999; Dreyfus

& Dreyfus, 1986; Klein et al., 2005). If noticing depends on both the stimulus and the perceiver, this implies that updating must be studied in context in order to develop a fuller understanding of the reciprocal influence of the stimulus and perceiver.

Second, a gap or discrepancy often triggers noticing. Cowan (1986) argues that noticing occurs when the discrepancies between what is being observed and what is desired accumulate past a particular threshold. However, Klein and colleagues (2005) disagree with Cowan and assert that noticing occurs when there is a discrepancy between what is observed and what is expected (rather than what is desired). This perspective is in keeping with the sensemaking literature, where violated expectations are thought to trigger sensemaking (Louis, 1980; Weick, 1995). Violated expectations can occur in several different ways: something expected doesn't happen, something unexpected happens, or something completely inconceivable happens (i.e. "bolt from the blue") (Weick & Sutcliffe, 2007). One implication of this research for my study of updating is that it is important to pay attention to how a need for updating is noticed in the first place, which may be visible in "marked moments" when individuals indicate, either to themselves or to others, that they have noticed that events are "taking an unacceptable trajectory and may require action" (Klein et al., 2005: 14). Examining what triggers and shapes noticing will help elaborate my theory of updating.

Third, how individuals talk about or label what they notice is also important for updating. Labels matter because labels shape and limit subsequent sensemaking (e.g., Jackson & Dutton, 1988; Weick et al., 2005). More specifically, labeling a stimulus puts it in an identifiable category, which then triggers "managing, coordinating, and distributing" (Weick et al., 2005: 411) or, in the language that I have been using in this

dissertation, a trajectory of cognition and action. If a stimulus is perceived as a threat, this perception can trigger a threat-rigidity response, limiting information processing and decreasing available behavioral and cognitive repertoires for responding to the change (Staw et al., 1981).

Although the literature on how changes in the environment become salient is a helpful starting point for studying updating, these models – with the exceptions of Klein et al. (2005) and Weick et al. (2005) – are dominantly individualistic and cognitive, neglecting how individuals situated in a particular context and engaged in interdependent work might interact with each other and the context to influence updating. The role of social interaction in updating is not often discussed. My research aims to fill this gap.

So how might social interaction influence updating? Individuals engaged in complex interdependent work, by the very nature of their work, must interact with others. Through their interaction, individuals engaged in interdependent work may serve as a resource for cognition and action for each other. For example, the literature on *advice giving and advice taking* suggests that individuals consider the advice of others when making decisions, weigh the advice, and subsequently sometimes change their mind about the appropriate course of action based on that advice. Bonaccio and Dalal, in their review of the advice giving and advice taking literature, write that,

Decision-makers seek out and attend to advice in order to share accountability for the outcome of the decision and to improve the probability that their decisions will be accurate or optimal (Harvey & Fischer, 1997; Yaniv, 2004a, 2004b). For instance, interacting with others prior to making a decision forces decision-makers to think of the decision problem in new ways (Schotter, 2003) and provides decision-makers with new information or alternatives not previously considered (Heath & Gonzalez, 1995) (2006: 129).

But decision makers often discount advice. Advice giving and advice taking does not occur in isolation, rather it occurs in a context where individuals engaged in interdependent work must persuade others to consider their ideas.

The idea of persuasion highlights that, in social interaction, meaning is negotiated. If we take the social constructionist perspective seriously, then individuals are engaged in negotiating an understanding of themselves and the environment. There are many literatures that touch on this idea of socially negotiated meaning-making, among them social problem theory, issue-selling, and sensegiving. *Social problem theory* (Kitsuse & Spector, 1973; Schneider, 1985) suggests that claims making and claims granting are important in determining which interpretation is seen as valid or legitimate (Dutton & Duncan, 1987). Likewise, the literature on *issue-selling* examines how individuals direct the attention of senior management to various strategic issues (Dutton & Ashford, 1993). Finally, the literature on *sensegiving*, which considers how individuals (usually leaders) attempt to influence “the sensemaking and meaning construction of others toward a preferred redefinition of organizational reality” (Gioia & Chittipeddi, 1991: 442). Taken together, these literatures that touch on persuasion and meaning-making highlight that it is important to pay attention to which individuals attempt to exert influence, how they shape their attempt, who is the target of their influence attempt, how their influence attempt is received, what makes an influence attempt more or less legitimate, and what happens when their attempts to influence are unsuccessful.

Having asserted that understanding interactions between individuals is vital to understanding updating, what do we know about updating in the context of interdependent work? The literature on high reliability organizations (HROs) suggests

several patterns of interaction that may facilitate updating (e.g., Roberts, 1990; Weick, 1993; Weick & Roberts, 1993; Weick et al., 1999). This literature emphasizes that the attitude that individuals engaged in interdependent work have toward each other and the ways in which they interact with each other are of paramount importance. Certain patterns of interactions – specifically *heedful interrelating* (Weick & Roberts, 1993) and *respectful interacting* (Weick, 1993) – are theorized to create an environment of heightened awareness, where weak signals (or small cues) are more likely to be noticed, interpreted, and responded to before they become large problems (Weick et al., 1999).

Heedful interrelating is a social process of creating joint action; in heedful interrelating, individual action contributes to a larger pattern of joint action and individuals understand how their actions fit into the larger action (Weick & Roberts, 1993). Heedful interrelating involves three elements – contribution, representation, and subordination – in which, “Actors in the system construct their actions (contribution), understanding that the system consists of connected actions by themselves and others (representation), and interrelate their actions in the system (subordination)” (Weick & Roberts, 1993: 357). Respectful interacting is a social process of creating joint meaning; in respectful interacting, an individual communicates meaning to another individual and, through this communication, a joint intersubjective meaning is generated. Respectful interacting evolved from Asch’s moral imperatives for cooperative knowing (see Campbell, 1990: 45) and requires the presence of trust, honesty, and self-respect.

While heedful interrelating and respectful interacting are theorized to be foundational for high reliability organizing (Weick, 1993; Weick & Roberts, 1993), little subsequent research has investigated how and when they occur and whether they actually

result in improved performance and error detection. A notable exception is research by Vogus (2004), who finds that heedful interrelating and respectful interacting predict higher levels of mindful organizing and are associated with decreased medical errors. The implication of heedful interrelating and respectful interacting for updating is that it is important to pay attention to the quality and nature of interactions between individuals. In particular, it is important to observe the ways in which heedful interrelating – or how individuals generate shared action – and respectful interacting– or how individuals generate shared meaning – play a role in updating.

Another literature that examines how individuals coordinate their work in order to update their understanding is the literature on *team adaptation*, particularly in response to unforeseen changes. Research on how teams adapt to non-routine events or unexpected changes again supports the idea that updating is difficult to accomplish but does occur (LePine, 1998; LePine, 2003; LePine, 2005; Okhuysen & Eisenhardt, 2002; Waller, 1999; Waller, Gupta, & Giambatista, 2004). For example, in a study of team decision making, LePine (1998) finds that only approximately half of the teams (53%) are able to adapt in response to an unforeseen change (a communication disruption in a simulated military command and control exercise); although it is discouraging that half the teams are unable to adapt, it is heartening that some of the teams are able to adapt to unforeseen changes. Below I review some of the findings from the team adaptation² literature that are relevant to updating.

² A quick note about the studies related to team adaptation: in these studies, various terms – such as teams, crews, or groups – are used to describe individuals engaged in complex interdependent work. However, functionally, these terms all mean roughly the same thing. Therefore, when reviewing the research I use the terms that the researcher has assigned but these terms can be thought of as interchangeable.

Overall, the research on team adaptation in the face of unexpected events draws attention to two facets of interactions: first, team adaptation is more likely if individuals working together are able to draw upon the resources (i.e. ability, information) that each individual team member brings to the team (e.g., LePine, 1998; LePine, 2003; Okhuysen, 2001; Okhuysen & Eisenhardt, 2002) and second, it may be that the timing of interactions between team members influences adaptation (e.g., Waller, 1999). I discuss each of these points in more detail below.

First, adaptation is more likely if teams are comprised of individuals with more resources and if the teams are able to draw on those resources (please note that I use resources broadly here to encompass not only raw ability, such as intelligence, but also other resources, such as information that the individual team members possess). LePine's research on team adaptation (1998; 2003) finds – not surprisingly – that teams comprised of individuals who have higher cognitive resources (i.e. are smarter) and who are more conscientious are more likely to adapt. Furthermore, he suggests that the best team member makes a difference to team performance in that team members with higher cognitive resources seem to be able to compensate for other team members with lower cognitive resources (LePine, 1998: 157-158). The finding that an individual team member can positively affect the whole team is in keeping with Bunderson and Sutcliffe's finding (2002) that successful teams have at least one generalist on a team and Paul Schulman and colleagues' suggestion that certain individuals acting as high reliability professionals may enable the whole group to function in a more reliable fashion (Schulman et al., 2004), however it is not clear yet *how* one team member might

influence the team (i.e. compensate for a weaker member). Understanding how a team creates the conditions that promote updating remains an unanswered question.

For some resources, such as information, it is not sufficient for individual team members to possess the information, they also need to be able to share and integrate the information in order for this resource to promote adaptation. Okhuysen's work on knowledge integration (Okhuysen, 2001; Okhuysen & Eisenhardt, 2002) is a good example of this. Okhuysen finds that groups must create moments for reflection ("self-interruptions") so that individuals within the group can raise concerns and surface important information and integrate knowledge. He writes,

When groups face unclear or uncertain problems, it may be difficult for them to determine ultimate goals or to design strategies for the effective completion of the tasks (Weingart, 1992). In these situations, it is important that groups adapt to their emerging understanding of their tasks. As groups are able to increase the opportunities to modify their strategies, and thus increase their adaptability, they are likely to be more effective in their tasks. Higher performance is a consequence of an increase in the number of self-interruptions because they are opportunities to reorient the activities of a group to the emerging understanding of the task. (Okhuysen, 2001: 797).

These moments of reflection or "opportunities to modify their strategies" seem to be most effective if groups have a few meaningful interruptions in work where the group process is carefully examined and modified on the basis of that reflection rather than having frequent small interruptions that do not result in process change and can actually hinder performance (Okhuysen & Eisenhardt, 2002)

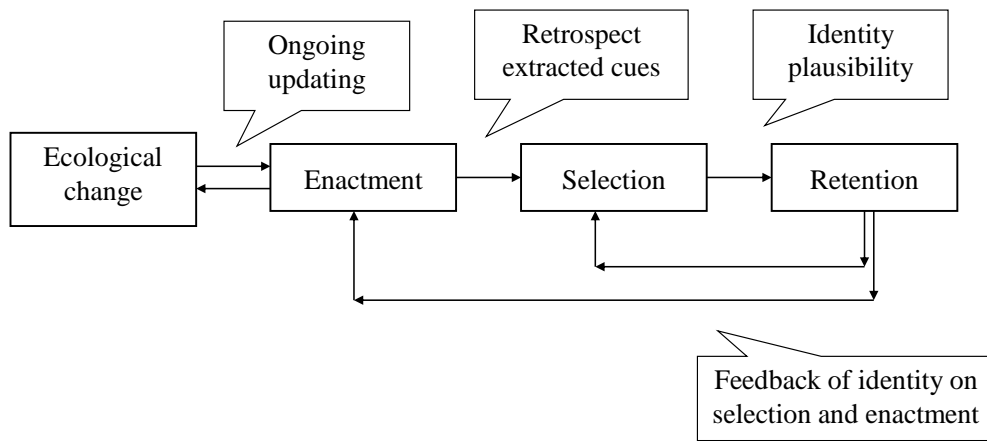
Second, the timing of interactions between team members seems to influence adaptation. Waller (1999) finds that crew performance was not associated with increased frequency of adaptive behaviors (such as information collection and transfer, task prioritization, and task distribution) but rather with the timing of those behaviors i.e. "the

longer that it took the crews to engage in adaptive task performance after a non-routine event, the lower the crew performance” (Waller, 1999: 135). Additionally, Waller and colleagues (2004), in their research on nuclear power plant crews undergoing evaluation in a high-fidelity simulation setting, find that few differences exist between high and low performing crews during monitoring or routine situations but significant differences do exist in non-routine situations. Specifically, high performing crews are better able to collect information, to develop shared mental models, and to use more effective communication processes within the crew. The implication of Waller’s findings for updating is that it is important to pay attention not only to patterns of interactions but also the frequency and timing of those interactions.

I now turn from a discussion of organizational literature related to updating to make the case for studying updating in a healthcare context, specifically the ED.

Figure 2.1

Process Model of Sensemaking



(Weick, Sutcliffe, and Obstfeld, 2005)

Chapter 3

Research Design and Methods

In this chapter, I describe and provide the rationale for the design of my dissertation research. I explain why I chose the work of ED healthcare providers as the context for my study of updating. I then provide more information about Children's Hospital, where I collected the data for my dissertation. I also provide an introduction to the methods that I used in my dissertation. I describe more explicitly the particulars of my context and analysis in the two empirical chapters – my field chapter and my simulation lab chapter – that follow.

Selecting a research context

Similar to many organizational constructs, much of the past literature related to updating has been acontextual, by which I mean that updating (or lack thereof) has often been studied in isolation, removed from the work that people actually do. Glaser and Strauss (1967) recommend choosing a context that brings the phenomenon into sharp relief. My goal, then, in selecting a research context was not to find a context that was most like a traditional organization, but rather to select a context where the phenomenon of interest was more extremely portrayed i.e. where updating was both difficult and imperative to accomplish.

When designing my study, I wanted to select a research site where sensemaking and updating were a core component of the everyday work, where there were multiple iterations of updating occurring within a short period of time (to increase the number of

observations possible), and where updating (or lack thereof) had important practical consequences. The ability for workers to update their understanding of an evolving situation is relevant to many industries but is particularly important in high-risk settings, such as nuclear power plants (Schulman, 1993), aircraft carriers (Weick & Roberts, 1993), and hospitals (Faraj & Xiao, 2006; Klein et al., 2006).

Given my background and my criteria, I selected healthcare as the broad context for my study of updating and – more specifically – I decided to study updating in the ED of an academic medical center. The work of ED healthcare providers involves making sense of a patient’s symptoms and updating their understanding as a patient’s symptoms change over time. There are multiple opportunities for sensemaking and updating. In an eight hour shift, a team of healthcare providers may care for 20-30 patients (Levin et al., 2007) and within each patient’s care lie multiple opportunities for updating. The ED is a setting where updating is both challenging and necessary: updating is challenging because the ED is a chaotic environment full of interruptions (Chisholm, Collision, Nelson, & Cordell, 2000) and because the ED is precisely the type of setting – given that actions of the ED staff are volitional, public, and often irrevocable – where we would expect the tendency toward commitment (and away from revisiting and revising) to be high (Salancik, 1977a). At the same time, updating is also necessary because, as patients’ symptoms change and evolve over time, ineffective updating can have lethal consequences (Fordyce et al., 2003; Kachalia et al., 2007; Kohn, Corrigan, & Donaldson, 2000).

In addition, the setting of an academic medical center allows the researcher to gain greater insight into how updating is being accomplished because this setting requires

that healthcare providers-in-training (student nurses, EMTs, residents, interns, and medical students) not only report the information that they have collected from and about the patient, as well as their working diagnosis and plan for investigation, but also report their thinking behind *why* they believe what they believe. Similarly, for teaching purposes, senior healthcare providers verbalize the logic behind their thought processes to residents in order to share how they approach specific problems. As a result, many of the thought processes that are usually tacit are made explicit, providing a window into the usually interior and silent activity of diagnosis

The work of an ED healthcare provider is complex. ED healthcare providers function in a very complex and unpredictable environment: work in the ED is unbounded, is frequently interrupted, involves caring for multiple patients simultaneously, is subject to high levels of uncertainty, is provided under significant time constraints, and affords little opportunity to practice risky procedures (Chisholm et al., 2000; Eisenberg et al., 2005). ED healthcare providers must be able to make sense of and manage a wide range of symptoms, spanning from situations as clear cut as a small laceration requiring sutures to situations as ambiguous as a patient who is brought to the ED because they have become confused and combative. This wide range of symptoms requires the ED healthcare providers develop a wide range of cognitive and behavior repertoires in order to manage these symptoms.

The work of an ED healthcare provider is interdependent: many different types of healthcare providers work in the ED. Most large hospitals have a range of providers including physicians, nurses, licensed practical nurses (LPNs), pharmacists, mid-level providers (physician's assistants and nurse practitioners), emergency medical technicians

(EMTs), respiratory therapists, and child-life specialists (trained to help calm and entertain children in distress). The care of patients in the ED is usually so complicated that a single individual working alone cannot diagnose and treat a patient.

Teams of ED healthcare providers are usually described as “temporary action teams,” (Faraj & Xiao, 2006: 1162). The teams are temporary because they are “a set of diversely skilled people working together over a complex task over a limited period of time” (Goodman & Goodman, 1976: 494). The use of the concept of “action teams” is common amongst scholars who have studied complex interdependent work in a variety of healthcare settings (e.g., Edmondson, 2003; Faraj & Xiao, 2006; Klein et al., 2006; Yun, Faraj, & Sims, 2005). The phrase, “temporary action teams” highlights two different yet important aspects of the care in the ED: the “action team” component consists of “highly skilled specialist teams cooperating in brief performance events that require improvisation in unpredictable circumstances” (Sundstrom, de Meuse, & Futrell, 1990: 121). The fact that teams are temporary action teams is important because many of the mechanisms that established teams rely on to coordinate activity are missing: relationships between team members cannot be presumed, team members may only know each other by the role that they play on the team, and team members need to be very explicit about what they are doing and why they are doing that.

Selecting a level of analysis

Updating can occur at many different levels of analysis. Because I am interested in the accomplishment of complex interdependent work, I focus on updating that

influences the *trajectory of care* of the patient. Strauss et al. define trajectory of care³ as “not only the physiological unfolding of a patient’s disease but the total organization of work done over that course” (1985: 8). As such, the concept of trajectory of care encompasses both the unfolding understanding and the unfolding action involved in patient care and provides a theoretical framework within which to analyze where, when, and how updating is occurring. The trajectory of care encompasses the “arc of work” involved in patient care and, by definition, highlights that patient care is a social and interdependent process. The concept of trajectory of care has been used in other organizational research as the unit of analysis to study team and group organizing (e.g., Faraj & Xiao, 2006; Klein et al., 2006).

In revisiting and revising the trajectory of care, healthcare providers are aiming for an increasingly plausible explanation of the patient’s symptoms, which can be characterized as “more comprehensive, incorporates more of the observed data, and is more resilient in the face of criticism” (Weick et al., 2005: 415). The accomplishment of updating as it influences the trajectory of care can, in the context of complex interdependent work, be thought of as a type of team performance. Recall that the trajectory of care of the patient is carried out and influenced by “action teams” of ED healthcare providers and, in patient care, the “brief performance” of the team revolves around an episode of care in which healthcare providers attempt to diagnose and treat the underlying cause of the patient’s symptoms. Team performance is complex and can originate from many different sources. Klein and Kozlowski write,

³ Although Strauss primarily described trajectories of care around chronic illness and suffering (or dying), this theoretical frame for understanding the organization of medical work is more broadly relevant and has been used more widely in recent years (e.g. Faraj, S., & Xiao, Y. 2006. Coordination in fast-response organizations. *Management Science*, 52(8): 1155-1169).

Team performance is a configural team property insofar as team performance emerges from the complex conglomeration of individual team members' performance. Depending on the nature of the team task, team performance may reflect the following: the sum of individual team members' contributions (the better each individual performs, the better team performance); the poorest team member's contribution (the team can perform no better than its weakest performer); the best team member's contribution (one team member can carry the team to a high level); the variability of team members' contributions (the more varied team members' contributions, the greater the number of nonredundant resources available to the team); or some more complex combination of team member contributions.(2000: 217)

By focusing on the trajectory of care as my unit of analysis, I keep an open mind about which actor (or actors) might accomplish the updating.

Selecting a research site

I wanted to find a research site where I could study updating as it occurred “in the wild” and also as it occurred in the more controlled setting of the medical simulation lab. Studies have been done either in the field – the ED – or in the simulation lab but, to the best of my knowledge, no studies have combined these two settings (although “in vivo” simulation research, where the simulator is taken into the clinical care areas of hospitals is becoming a more popular way to do simulation research).

My dissertation research took place at Children's Hospital (pseudonym), a large urban Midwestern research and teaching hospital that is routinely ranked among the top 10 pediatric hospitals in the US. I chose Children's Hospital because their ED is one of the busiest pediatric EDs in the country with an annual census of approximately 91,000 patient visits and averaging 246 unscheduled visits per day. The ED provides care for a spectrum of patients from patients with minor ailments (i.e. ear infections, upper respiratory tract infections) to patients with extremely rare and complex medical conditions requiring subspecialist care. Children's Hospital is a Level I Trauma Center,

which means that this facility receives patients from a wide geographic region who have been seriously injured in accidents or had some other kind of trauma. As well, Children's Hospital has an on-site simulation lab where ED healthcare providers and Trauma Team staff regularly participate in simulation scenarios for both training and evaluation purposes. This simulation lab – in contrast to many labs around the country – trains interdisciplinary teams of healthcare providers in the simulation, rather than focusing on one group (i.e. physicians). The interdisciplinary nature of this simulation training is critical to my research design.

It was difficult to gain access to a research site – I spoke to clinicians around the country for almost a year before being introduced to Children's Hospital. Children's Hospital senior leadership was enthusiastic about my project and helped facilitate access. There were significant human subjects concerns about observing healthcare workers engaged in direct patient care and it took another year to obtain human subjects approval from all the appropriate parties. I had approval from the University of Michigan's Behavioral Institutional Review Board (IRB), from the Children's Hospital's internal IRB, and from the National Institute of Health's Certificate of Confidentiality program, which protects my data from subpoena, a necessary safeguard given the sensitive and potentially litigious nature of work in which ED healthcare professionals are engaged.

Selecting a research design

As mentioned previously, I wanted to study updating in two contexts: the ED and the medical simulation lab. For the first study, set in the Children's Hospital ED, my data were non-participant observations and archival digital video footage of patient care in the critical care area of the ED. The goal of my first study was to develop a theory that

provided insight into different patterns of updating and how updating was accomplished as part of everyday work. For my second study, set in the Children's Hospital medical simulation lab, my data were video footage from the simulations. The goal of my second study was to elaborate and refine the theory that I developed in the first study. I begin with a brief overview of the methods that I used to investigate my research questions: "What does updating look like?" and "When and how does updating occur?"

Barley and Kunda assert that organizational researchers rarely study how work is actually accomplished and issue a call to scholars to "bring work back in" (2001). Similarly, Hoff and colleagues (2004), in their review of journal articles that examined organizational factors in medical error, critique many of the existing studies – noting that the studies were often atheoretical or methodologically weak – and call for more rich descriptive work grounded in theory. I answer these calls for studying work as it is accomplished – specifically, I draw on ethnographic techniques (non-participant observations) and microethnographic techniques (video analysis) in order to study how updating occurs in the context of complex interdependent work as it unfolds in real-time.

Ethnography focuses on understanding social phenomenon and culture by closely observing patterns of behavior (Locke, 2001; Patton, 1990). Non-participant observations entail spending time in the field and being immersed in the day-to-day activity of the research subjects. Microethnography (sometimes called video-based ethnography) focuses on understanding situated human interaction as it unfolds over time, particularly with respect to how people use language, action, and tools to make sense together from moment to moment (Heath & Hindmarsh, 2002; Heath, Luff, & Knoblauch, 2004). Video analysis entails logging, transcribing, and coding video and is grounded in a multi-modal

perspective, which asserts modalities of human communication – such as speech, gesture, writing, etc – are misunderstood if studied in isolation. Multimodal research seeks to integrate “modalities and their interaction and their interaction with features of context in everyday cognition, work, and social life” (Goodwin, LeBaron, & Streeck, 2008 (under contract), p. 1 book proposal).

In the subsequent two empirical chapters, I go into detail about my data sample, collection, and analysis. I begin with my field chapter (Study 1), followed by my lab chapter (Study 2).

Chapter 4

Updating in the Emergency Department

Updating, which I have defined as “a process through which actors revisit and potentially revise their understanding of and response to an evolving situation,” is a fundamental but poorly understood aspect of organizing. Prior research suggests that updating is difficult to accomplish (e.g., Anderson et al., 1980; Nickerson, 1998; Nisbett & Ross, 1980; Staw, 1976) but is important for adapting to unexpected events and for detecting and correcting error early in its unfolding (e.g., Burke, Stagl, Salas, Pierce, & Kendall, 2006; Waller, 1999; Weick et al., 2005). However, what updating looks like and when and how updating occurs remain open questions. In order to address this gap in the literature and learn more about updating, I conducted an inductive exploratory study of updating in a context where updating is critically important: the ED.

In this study, I use data from non-participant observations in and archival video footage from the ED to develop a deeper understanding of how updating is (or is not) accomplished as part of everyday work. I found that ED healthcare providers were able to update their understanding of a patient’s changing medical condition but that updating was constrained by many contextual features of the ED. I found that healthcare providers, in an attempt to facilitate updating – something they recognized was important yet difficult to achieve – engaged in proactive routines to help facilitate updating. Last, my findings suggest that whether and when updating occurred depended on the nature and type of social interactions that shaped revisiting and revising the trajectory of care. I

introduce a framework for thinking about these interactions as either implicit or explicit bids for attention that are either sensemaking or sensegiving in nature. Having already situated my research questions within the literature in the previous chapter, here I present some other influences on my theory development. Next, I provide more details about the context and method for this study and, last, I present my findings and conclusions.

Developing theory around updating

Updating is a moment in the larger process of patient care when one or more members of the team return to the trajectory of care, reconsider the trajectory, and potentially revise it. I situate updating at the juncture where the sense made at one period in time (s_1) is reconsidered and a new sense may be developed (s_2) (see Figure 4.1). It is important to emphasize that updating, by definition, occurs only in situations where some sense has already been made and the main function of updating (theoretically speaking) is not around making sense from ambiguous or uncertain information but rather around determining whether the course of cognition and action that has been decided upon remains appropriate. In updating, there is a comparison and evaluation component that is often absent from naïve sensemaking. Updating occurs in face of an already established trajectory of care and, in many ways, is about the refinement of understanding. I use the term “refinement,” which has its etymological origin in the metallurgical practice of separating metals from dross or other extraneous matter (*Merriam-Webster’s Collegiate Dictionary*, 2002), to emphasize that once a trajectory has been initiated, there can be adjustments in understanding that polish, or improve, or clarify the trajectory but that traces of the trajectory’s initial elements remain.

As I gathered and analyzed my field observations, I found the work of Mary Parker Follett (Metcalf & Urwick, 1957), who writes about “moments in a process” that punctuate a flow of activity, to be helpful in building theory around how updating occurs. In this study, I am examining how healthcare providers update their understanding of a patient’s trajectory of care as the patient’s medical condition evolves over time. Updating is, in some ways, the reactivation of sensemaking but it is not just a simple triggering of sensemaking; updating is also a complex process with its own cognitions and behaviors that relate to how actors negotiate their way from one sense to another.

Finally, a quick aside, before I turn to the methods section, about how I determined that it was feasible to study updating. As mentioned in the literature review chapter, there is a significant disagreement in the organizational literature around whether and when updating occurs. In fact, the organizational literature was divided enough on this topic that, prior to starting my dissertation research, I engaged in an extensive pilot study (approximately 200 hours of observations in the ED of another large Midwestern research and teaching hospital) to explore whether it would be possible to observe updating as part of complex interdependent work. I found field observations to be a rich source of data for studying updating and so I decided to proceed with this dissertation.

Chapter-Specific Research Design and Methods

Research context

In this section, I build on the rationale introduced in Chapter 3 (Research Design and Methods) to illustrate why the ED is an apt location for studying updating and to bring my particular research context to life. As mentioned previously, in order to learn more about updating as part of everyday work, I wanted to study updating in a context in

which updating (1) was a central component of the work, (2) occurred frequently, and (3) had practical importance. As I have argued before, the ED is a context where updating is both challenging and necessary. The ED is the interface between the organization and the environment and is often referred to as the “front door” to the hospital (Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, 2007). The ED is a context where, more than any other area of healthcare, high levels of uncertainty are part of daily work. Work in the ED is, “unbounded in scope, unpredictable, and potentially unlimited in demands” (Cosby & Croskerry, 2009: 5). Croskerry and colleagues, in the preface to their book on patient safety in the ED, write,

It [the ED] is an environment like no other. The diversity of conditions has no match in any other area of medicine, and nowhere else is the decision density as high nor the cognitive and emotional load so heavy. Its richness and variability make it a special place to be and a fascinating place to work. But the nature of the environment that makes it interesting comes with a price. . . . The ED environment has been fittingly described as one that is prone to error, and even a natural laboratory for the study of error. Perhaps more than any other area of medicine, purposeful and deliberate attention to safety is necessary to coordinate the complexity of multiple processes and people required to run an ED. (2009: xiii)

The data from my dissertation come from Children’s Hospital, a large urban Midwestern research and teaching hospital that is routinely ranked among the top 10 pediatric hospitals in the US. As mentioned previously, Children’s Hospital is a Level 1 Trauma Center, which means that this facility receives patients from a wide geographic region who have been seriously injured in accidents or had some other kind of trauma. In addition to being one of the best pediatric hospitals in the US, it is also one of the busiest. There are over 90,000 visits per year to the ED, which averages out to about 250 visits per day.

The ED is staffed by many different kinds of healthcare providers, with over 50 Emergency Medicine (EM) physicians on staff (combination of teaching and clinical faculty), other physicians who serve on the trauma team (such as trauma surgeons, orthopedists, anesthesiologists, etc), pediatric emergency medicine fellows, a variety of residents from a number of different emergency services residency programs, medical students, pediatric nurse practitioners, EMTs, nurse anesthesiologists, ED nurses, operating room nurses, LPNs and nurses' aides, respiratory therapists, child life-specialists, social workers, clergy, and a pharmacist who specializes in ED care. In addition to the healthcare providers, there are a number of administrative personnel – for example, registration clerks and ward clerks – who play a key role in registering the patient, arranging the flow of patients through the hospital, requesting old patient records, and coordinating billing.

At my dissertation research site, senior ED physicians play one of two roles: they are either teaching faculty or clinical faculty. Teaching faculty see patients in conjunction with a team of fellows, residents, interns, and medical students – when supervising learners, the attending physicians had to not only monitor how the patient was doing but they also had to monitor how the physicians-in-training that they were supervising were doing. In contrast to teaching faculty, clinical faculty see patients on their own. ED physicians sometimes alternated between these two roles (i.e. on one shift they were teaching faculty and on another shift they were clinical faculty) or sometimes crossed between roles within the same shift (i.e. clinical faculty would occasionally supervise a resident). In either role (teaching or clinical faculty), ED physicians collaborate with the

range of other ED healthcare providers (mid-level providers, nurses, social workers, etc) to care for patients.

There are multiple healthcare providers on shift at any given time but the length of shift and when the shift begins and ends varies between and within various types of healthcare providers to ensure overlapping coverage (for example, nurses work 12 hour shifts, while attending physicians work eight hours) and to allow for double (or triple or quadruple) coverage of key roles during times of peak demand (for example, each area in the ED may have their own head nurse and own attending physician assigned to them).

The entire hospital, including the ED, is designed to make care as pleasant as possible for children and their families. It is decorated to be as appealing to children as possible, with bright colors and cheery murals on the walls. In the ED, there are seasonal decorations hanging from the hallway ceilings (in the spring there were paper cut-outs in the shape of shamrocks and raindrops and umbrellas; in the summer, the paper cut-outs were all sorts of flowers). Even the portable x-ray machine in the ED is decorated to look like a fire truck. Most of the nursing staff wears colorful apparel (called “scrubs”) with cheerful designs or cartoon characters on them and even the masks that they put on during patient care have cartoon characters on them. Children and their families are provided with movies or cartoons while they wait (TVs are in each exam room) and can order food from the cafeteria menu (if they are allowed to eat). The hospital employs a number of child-life specialists, who are experts in child development and are trained to help children cope with challenging experiences (for example, they help calm and distract children who are getting sutures or having a procedure done). There are several child-life

specialists who are assigned to the ED and attend every trauma page. As well, there are social workers and clergy on staff to support family.

Patients present to (this is a term that healthcare providers use, which means “come to”) the ED via at least three routes: (1) they decide on their own that they need to be seen in the ED and go there, (2) they are seeing another physician who refers them to the ED (and usually calls the ED to let the staff know the patient is coming), (3) they are brought to the ED via emergency medical transport (i.e. ambulance). A central premise of ED care is the idea of *triage*, which means that patients are seen according to how urgent their need is for care: someone who has been in a car accident is seen immediately, whereas someone who has a fever and cough might have to wait for hours. Children’s Hospital has a triage area just off of the patient registration desk and the ED waiting room where patients are seen upon arrival by senior ED nurses who assign them a triage score, indicating how urgently they need to be seen.

The ED at Children’s Hospital is divided into a number of different clinical care areas (see Figure 4.2 for blueprint of ED). The most critically ill patients are brought into the Shock Trauma Suite (called the STS or sometimes the “trauma bays”). There are another four areas in the ED designed for varying levels of acuity of patient care. Depending on the patient volumes, different areas of the ED are opened up for care (during slow times, areas like Area D and Area E are kept closed). The sickest patients (not being seen in the STS) are sent to Area C, where the patient rooms have large windows so that the staff at the workstation can keep an eye on the patients. In descending order of acuity, patients are brought back to rooms in the STS, Area C, D, B, A, and E (the acute care area).

The STS is where many of my observations took place. As you can see from Figure 4.2, the STS is a large open space, with multiple entrances and exits, which is divided into three trauma bays (each with their own curtain to close off the area; each with dedicated equipment, including monitors, medication carts, etc). There is a long counter along one wall where nurses can prepare medications. There is a direct path from the ambulance bay (where ambulances park) to the STS. Children’s Hospital, like many hospitals, has moved from having families excluded from traumas and codes to allowing them to be present, as long as they stay out of the way of healthcare providers. In the STS, there is a red line of tape on the floor marking off where families can stand (often one family member – for example, the mother – is allowed at the bedside to help comfort and restrain the child). The trauma bays each have a motion-activated camera that records all activity (families sign waivers upon admission giving permission for these videos to be used for quality improvement and research purposes).

Below I describe my research design, data sample, collection, and analysis. Please note that I used two different types of data in this study – archival video footage from the ED trauma bays and non-participant observations in the ED. I began with the ED video and then progressed to observations but, in keeping with a grounded theory approach, the data collection and analysis progressed alongside each other as I iterated between data, creating theory, collecting more data to elaborate my theory, and so forth, until I reached “theoretical saturation” – the point at which new data does not generate new theory (Glaser & Strauss, 1967; Locke, 2001). In addition, analysis of the data continued after I left the field.

ED video

Research design: I began my study of updating “in the wild” by analyzing archival digital video footage from the ED. There were two main theoretical advantages to collecting and analyzing ED video footage before I began the ED non-participant observations. First, it was difficult to know what to pay attention to in the non-participant observations without a set of “sensitizing concepts” (Blumer, 1954) to act as a guide. Sensitizing concepts orient and focus the researcher; coding video around moments of updating (or where it seems as if updating should be occurring but is not) before going in the field allowed me to have a sense of not only what updating looked like but also what conditions seemed to co-exist with or precede updating. The ability to pause and rewind and see what is happening in the moments before updating occurs is not possible in the field.

Second, video captures moments that could be missed by an observer. Non-participant observations rely on the observer as research instrument. There is the possibility that biases the researcher holds may influence their perception of behaviors and interactions in the field. This issue is particularly problematic for a physician researcher, like me, in a healthcare context. Being able to step back and systematically and repeatedly review video helped mitigate potential bias.

Data sample and collection: As mentioned above, Children's Hospital has motion-activated cameras mounted on the ceiling in the trauma bays that record all ongoing care of patients requiring evaluation and/or treatment in the critical care area of the Children's Hospital ED. This archival data was part of a pre-existing data set that Children's Hospital collected for medical education and quality improvement. I was able to engage in theoretical sampling because, at Children’s Hospital, all the ED trauma bay

video is routinely reviewed by patient safety staff for quality assurance purposes. I was able to ask them for video that focused on particular issues (for example, codes that involved healthcare providers from different disciplines) or that matched times when I had been doing observations in the ED. I sampled video collected at various times in the ED over a period of approximately five months (from March 2008 to July 2008). In total, I watched approximately 20 hours of ED video (videos ranged in length from 12 minutes to over an hour).

Data analysis: I followed LeBaron's recommendations (2007) about coding video – I began by logging the video, flagging general moments of interest and searching for instances of my phenomenon, giving special attention to boundary moments (such as opening, closings, and transitions), marked moments (where subjects indicate to each other that the moments are important), tensions and paradoxes. Once moments were selected, I transcribed the video. For confidentiality reasons, I was the only person who could view and transcribe these videos (i.e. I could not have research assistants code them as well). From a technical standpoint, it was quite difficult to transcribe these videos. There were usually multiple actors talking at the same time and the environment of the trauma bay was an extremely noisy one.

I used March Evidence Reader to view the ED video (it was encrypted and could only be seen through this software) and QSR International's NVivo 8 to manage and analyze my field notes and transcripts from the ED video. I iterated between analyzing video and gathering and analyzing field observations until I reached theoretical saturation. Once I had a sense of what updating looked like and when and how it occurred from video analysis, I began non-participant observations in the ED, observing

how updating was accomplished around a patient's changing medical condition by the healthcare providers as they performed their everyday work. As I began to review the video, I was first overwhelmed by the chaos and noise in the setting. Eventually, I began to see patterns of interactions amongst the chaos. I tried to identify what the healthcare providers were doing to actually be able to accomplish their work in this setting. As I continued to review video and began non-participant observations in the ED, I realized that healthcare providers recognized the difficulties associated with updating as they themselves were often overwhelmed by the setting. With this insight, I began to look for behaviors common between different healthcare providers that addressed the challenges to updating.

ED observations

Data sample and collection: I began with a brief period (two weeks) of general observations (in order to understand how the ED was configured, what types of healthcare professionals worked where, workflow, etc). I then engaged in approximately four months of non-participant observation in the ED (from April 2008 – July 2008). My observations generated hundreds of pages of field notes.

In the pilot study for my dissertation, I had tried a variety of different approaches to non-participant observations and found that it was most helpful to shadow specific healthcare providers (particularly resident or attending physicians) as they worked. I shadowed healthcare providers because I was interested in observing their understanding of the patient's trajectory of care as it unfolded over time. Much of the time I shadowed the attending physicians because they were the individuals who were ultimately

responsible for altering the patient's trajectory of care and were the individuals to whom the other healthcare providers reported.

A key difference in my study, in contrast to other researchers who have employed shadowing (i.e. Fletcher, 1999), was that I was unable to take notes while observing. There were two reasons why I did not take notes in the field – one practical and the other theoretical: first, I was unable to obtain approval through IRB to take notes while observing; second, in conversation with other scholars who have experience with ethnographic observation in the ED (Hoff, personal communication) I was warned that taking notes in front of the participants would make people reluctant to speak freely. Instead, I trained myself to memorize dialogue, interactions, and patterns of events and would excuse myself at frequent intervals and go to my office (down the hall) to make field notes about my observations. When shadowing, I observed the participants as unobtrusively as possible. In order to learn more about what happened during a shift related to updating, I supplemented the shadowing with questions of clarification during the shift (if questions wouldn't disrupt workflow) or just after the shift. Detailed field notes were usually written immediately after the observations and no field notes were written more than twelve hours after observations.

In this study, the goal of shadowing was to watch how updating unfolded from the perspective of a particular healthcare provider – for example, to observe how they spoke about and acted upon their understanding of a patient's diagnosis or to observe how they interacted with other healthcare professionals to make sense of the patient's symptoms or to accomplish the complex and interdependent work of patient care. I was particularly alert for moments where the healthcare provider revisited and/or revised their

understanding of a patient's condition. The observations were conducted on a convenience sample i.e. the staff members observed will be those working during the shifts selected. I sampled a full range of shifts – including daytime, night time and overnights, weekdays, weekends, and holidays – but found shifts later in the day to be more generative for observations as the ED tended to be busier then.

ED employees were considered a vulnerable population, so I took several steps to protect them. First, I spoke with key personnel and got their “buy-in” for the study. Second, I attended multiple staff meetings for various ED healthcare providers to tell them about the study and also sent out focused emails and put flyers in their mailboxes. Third, I used a protocol that allowed staff to anonymously opt-out of observations if they were not comfortable being part of the study – in this study (as well as my pilot study), no staff ever opted out of observations.

Data analysis: In keeping with the grounded theory methods described by Glaser and Strauss (1967), I used constant comparison to develop and verify concepts, and I shifted my sampling strategy (around where to focus my observations) accordingly. For example, I noticed that questions were emerging as an important factor in updating so I focused my observations on understanding what sorts of questions people asked, who asked questions, what function questions served, and so on.

Just as I looked for key moments in the video – boundary moments, marked moments, tensions or paradoxes – I coded my field notes for moments that seemed striking. Boyatzis (1998) refers to these moments that are striking as “code-able” moments – either because they seem interesting or because they seem recurrent or basic. I coded data into units of meaning, then analyzed these codes for themes and emergent

theoretical insight, and then returned to the data for further analysis and coding based on the new insights that I developed. As well, I followed the recommendations of Miles & Huberman (1984) to look for outliers, negative cases, rival explanations, and other discrepant information. As I collected and analyzed the data, I also regularly wrote analytical memos, which were short notes that captured my impressions, emerging insights, questions, and puzzles as I made sense of the data (Miles & Huberman, 1984).

As my observations and analyses continued, I began to notice that how people interacted with each other influenced when and how updating occurred. As a result, I engaged in theoretical sampling and focused my observations around certain types of interactions – for example, for a period of time, I studied how people used questions to facilitate updating. After awhile, a certain type of interaction around requests or bids for attention emerged as key to updating. In this type of interaction, a team member who had a concern about the patient’s trajectory of care would attempt to re-direct the attention of the team back to the patient’s trajectory of care. For example, an individual healthcare provider might notice that the patient’s clinical condition had worsened despite ongoing care and they would bring this concern to the attention of other team members.

These requests for attention from a team member to other team members seemed analogous to the pattern of requests (bids) for emotional connection described by Gottman and colleagues (e.g., Bakeman & Gottman, 1997; Coan & Gottman, 2007; Gottman & DeClaire, 2001). Gottman et al. have developed a rich vocabulary for describing social interactions in marriages and elaborated a coding scheme for evaluating the process of “bids and turning,” which consists of bids for emotional connection and responses (turns) to those bids. It occurred to me that Gottman’s framework could be

modified to examine bids for attention instead of emotional connection and so I developed a typology of bids for attention (and responses to those bids), which will be discussed in more detail in the findings.

Even after I left the field, I continued to re-view the ED video and re-read my field notes. As I coded and re-coded data, my codes evolved over time – for instance, I initially had codes around distinct moments of revisiting and revising but eventually realized that it was often difficult to disentangle these moments and supplemented my analyses with more holistic codes that identified updating trajectories, sources of updating, impediments to updating, etc. In addition to supplementing my codebook with new codes, I also differentiated older codes into more precise categories – for example, near the end of my analyses, I divided my code on bids for attention into (1) sensemaking bids (an attempt to persuade other team members to recognize that there is a problem and revisit the trajectory of care) and (2) sensegiving bids (an attempt to persuade other team members to revise the trajectory of care in a particular way).

Findings

My findings are organized around my two research questions, “What does updating look like?” and “When and how does updating occur? First, my findings suggest that updating does occur as part of the everyday work of healthcare providers and is shaped by the contextual constraints of the ED. Second, I find that healthcare providers in the ED are acutely aware of the challenges to update and I identify three ways in which they attempt to proactively manage these challenges through (1) deliberately revisiting the trajectory of care and (2) surfacing expectations, and (3) communicating richly. Third, I find that updating as part of complex interdependent work is deeply intertwined

with attention management and that social interactions – in the form of bids for attention (and responses to those bids) – shape whether and when revisiting and revising of the trajectory of care happens. Bids for attention occur when a team member attempts to focus the attention of the team on something they have noticed (or realized) with other members of the team, with the intent to have the team revisit (and possibly revise) the trajectory of patient care. These bids serve multiple purposes and can either be sensemaking or sensegiving in nature; as well, these bids vary in their explicitness. I illustrate these different types of bids and begin to explore their significance for updating.

Updating was shaped by contextual constraints

During my field study, I became aware of the influence of several additional features of the ED on the sensemaking and updating related to patient care. As mentioned previously, ED staff have limited control over the inputs of their work (i.e. the flow of patients), there is often little past history available on patients (especially if they are severely injured or cannot communicate for some reason i.e. are in a coma), there are significant time pressures (and the speed-accuracy tradeoff isn't one that healthcare providers want to – or can – make), and the staff are caring for multiple patients simultaneously (therefore, attention is divided amongst many patients, at varying stages of care) (Croskerry, Cosby, Schenkel, & Wears, 2009; Eisenberg et al., 2005).

In particular, my findings suggested that updating was shaped by four aspects of patient care that were unique to the setting of the ED: (1) patient care in the ED has a variable tempo, (2) patient care in the ED is episodic, (3) patient care requires maintaining multiple sensemaking “threads⁴,” and (4) patient care aims toward accuracy.

⁴ I use “threads” in the same sense as “train of thought”

First, patient care in the ED has a variable (but usually fast-paced) tempo, which fluctuates both within specific episodes of patient care and within the ED more generally. By tempo, I mean “the rate of activity” (*Merriam-Webster’s Collegiate Dictionary*, 2002). ED healthcare providers are very attuned to the tempo of their work. When the tempo is faster, staff (e.g., nurses and physicians) are “pulled” into the ED (in fact, the call schedule includes people assigned as “jeopardy” staff, which means that they can be called in to work if the ED gets too busy). When the tempo is slower, staff are called at home and told to report in later than the scheduled start of their shift because they aren’t needed at that moment.

Staff demonstrated their sensitivity to tempo in other ways. ED staff are superstitious about quiet times or lulls in pace: a fast way for a newcomer to the ED to earn a stern rebuke is to remark, “Oh, it seems quiet right now.” To which they respond, “Shh, don’t jinx it” or “We don’t say *that* word here” (*that* word refers to “quiet”). As well, staff – especially ED attendings and charge nurses (who are the nurses in charge of handling the flow of staff and patients in the ED) – are always aware of the backlog of patients waiting to be seen. Staff will regularly check the electronic patient registration system to see how many patients are “queued up” and waiting to be seen in the ED (even when they aren’t working that shift, ED attendings often check the electronic “queue” – or list of patients registered but not yet seen – from the computers on their office desks!). These ebbs and flows in tempo shape the sensemaking and updating nested within patient care. For example, when the tempo is faster (either because of greater numbers of patients or because of higher complexity/acuity of care), there are increased sensemaking demands on the staff (Sutcliffe & Weick, 2008), which makes updating more difficult.

Second, patient care in the ED is episodic. In the ED, patients present to the ED for acute problems, are cared for by a set of healthcare providers they likely do not know and likely will not meet again, and then leave, sometimes with planned follow-up at their primary care provider's office or a specialist's office. The ED, traditionally, has been a place where "serious illness and injury were quickly addressed and, it is hoped, cured, with the patient admitted if necessary" (Siegel, 2004). Even though an increasing number of patients are using the ED not only for episodic care but also for ongoing care, EDs (and the systems that support them) are not designed well for continuity of care or patient follow-up (Institute of Medicine Committee on the Future of Emergency Care in the United States Health System, 2007).

Episodic care poses several challenges for sensemaking. First, episodic care is problematic in the face of evolving and progressive diseases. If the timeframe when patients are seen by healthcare providers is either too brief or too early in the progression of the disease (i.e. before the patient's condition "declares"⁵ itself), it is often difficult for providers to accurately ascertain the cause of the patient's symptoms. In this case, patients often return to the ED for re-evaluation when their disease progresses. Second, episodic care interferes with the development of healthcare providers' skills as sensemakers. Because they only see patients for short periods of time and infrequently get feedback about the accuracy of their sensemaking, ED healthcare providers often have difficulty learning about their successes and failures of sensemaking and updating

⁵ The language of a disease "declaring" itself is used by healthcare providers to capture the notion that diseases have natural histories (i.e. symptoms evolve in a predictable sequence over time). In the early stages, it is often difficult to determine what the cause of a patient's symptoms are but – over time – more symptoms develop or symptoms evolve and the cause of the patient's symptoms becomes clearer.

(Chern, How, Wang, Lee, & Graff, 2005; Croskerry, 2000; Croskerry et al., 2009; Wears & Schiff, 2005).

Third, patient care in the ED requires that healthcare providers create and maintain multiple sensemaking threads⁶. For example, a recent study on workflow in the ED by Levin and colleagues (2007) showed that, during high demand times (3-7pm on weekdays), the average treatment area census (number of patients receiving care) was 26 patients and individual physicians were responsible for the care of up to 14 patients (it is worth noting that the ED in Levin et al.'s (2007) study had an annual volume of 43,000 visits per year, which is less than half the volume seen at my dissertation research site). While updating moments occurred within a specific patient's trajectory of care, healthcare providers care for multiple patients simultaneously and so their attention is divided amongst many patients. As a result, healthcare providers have to create and maintain many different sensemaking threads (one for each patient under their care, all of whom could be at differing stages of treatment). As well, because their attention is often split between patients, they are exposed to information discontinuously. When the ED became busier – either because there were an increased number of patients being seen or because the patients being seen were more complex – the sensemaking burden on staff also increased. Caring for multiple patients simultaneously has the potential to lead to information and interpretation overload (Sutcliffe & Weick, 2008).

Fourth, in the setting of the ED, accuracy – as well as plausibility – mattered. In medicine, there is a saying, “When you hear hooves, think of horses, not zebras,” which is used to emphasize that – for medical diagnoses – common things are common.

⁶ I use the term “thread” analogously to “train of thought”

However, the ED is an exception to this rule. In the ED, the trajectory of patient care is fundamentally about making sense of the patient's symptoms and providing the appropriate treatment as quickly as possible. In particular, the role of the ED healthcare providers is to rule out life-threatening illnesses, regardless of whether they are very probable (plausible). In this context, accuracy counts and even if the healthcare providers can't determine the diagnosis, the accuracy around appropriate treatment and disposition is very important.

This focus on accuracy may seem out of keeping in terms of how sensemaking is usually described: Weick writes that sensemaking is about plausibility not accuracy (1995: 55). Furthermore, Weick and colleagues argue that “[s]ensemaking is not about the truth and getting it right” (Weick et al., 2005: 415). Yet this claim depends, in part, on what the focus or target of the sensemaking is. Certainly, for many situations, it may be that there is no right answer or underlying truth to discover. However, in many situations where sensemaking is the core of the work, the actors involved in sensemaking are trying to “get it right.” In medical diagnosis there is a paradox: the people engaged in sensemaking have a positivist orientation, even though the way in which they accomplish their work is socially constructed (Wears & Nemeth, 2007). It is this blending of the positivist (the belief that there is a right answer) along with the social constructionist (the way in which the diagnosis and treatment are negotiated through social interaction and interpretation) that makes this such an interesting context to study.

Healthcare providers were aware of challenges to updating

One of the dominant themes that emerged from my observations was that attention is a scarce resource in the ED. I had never been in a work place that was so

chaotic, so noisy, and so full of interruptions. It amazed me that anyone could get any sort of work done, let alone the type of complicated high-stakes work that ED healthcare providers perform. Healthcare providers were acutely aware that a patient's medical condition could evolve (or devolve) over time, sometimes changing quite precipitously.

One senior ED physician described working in the ED this way:

It's a crazy place, the longer you do it, the nuttier it seems. It's amazing; it's amazing that anything gets done right.... I'm not sure that people appreciate that; they understand that it's busy, they understand that it's hectic, they can see that it's hectic but the understanding that every patient is virtually entirely new and you are sorting out [patients] and the detail to which we have to sort things out now, compared to what it was ten or fifteen years ago. I mean, all the tests have to be sorted out. They [the patient] have to be wrapped up in a bow before they get admitted. Plus, you don't want to admit them until they actually have to be in the hospital because they'll just be waiting around for ten hours for a bed or using a bed that you want the next person to be in. It's definitely become a harder and harder and harder job over time.

One of the sources of scattered attention was interruptions. The ED is a context full of interruptions: phone calls from physicians outside the hospital requesting advice or requesting to transfer a patient to the ED, pagers going off, people interrupting to ask about administrative details or patients from another shift, etc. Healthcare providers are often frustrated by the number of interruptions; when I was collecting my field data, one of the physicians I was shadowing turned to me and said, "Make sure that you put interruptions in your paper" and went on to clarify that interruptions were one of the most challenging aspects of her job.

There were certain times when interruptions were more troublesome than others. Interruptions were particularly problematic when they disrupted one healthcare provider relaying a patient's history and physical to another provider (either to get their opinion on the care or to transition care from one provider to the other). The norm at my dissertation

site seemed to be that if someone had a question but the person they wanted to talk to was in the midst of a “report out” (when the story was being relayed), they would stand nearby until the report was completed and then ask their question. However, if their question was urgent, they would interrupt, usually apologizing as they did so. In one instance, I was watching a resident present a patient to the attending I was shadowing; during the discussion of this patient, another resident came over to the attending, touched her on the arm, and said “Sorry to interrupt but her BP [blood pressure] is 68/40.” This statement referred to another patient they shared in common; a BP of 68/40 is dangerously low. There was a brief conversation about what to do about the low BP i.e. whether the resident should start another IV, give more fluids, make sure steroids that had been ordered were given, order more lab tests to attempt to determine whether patient’s condition was worsening, etc. Once this issue was addressed, the attending turned back toward the other resident they had been talking to. It took a minute to get back on track with the first presentation and to figure where they had left off in the patient’s story.

Not only was the timing of interruptions problematic, the sheer volume of interruptions created difficulty around sensemaking and updating. Healthcare providers often experienced multiple interruptions in a short period of time. Here is another example from my field notes:

An ED attending was attempting to finish charting. She kept repeating, “Don’t talk to me, I’m trying to finish these charts” but still experienced multiple interruptions. Within a few minutes she had (1) a request from a ward clerk to sign off (electronically) on a chart of the patient in B2 who was going upstairs to be admitted, (2) an outside phone call announced by colleague returning from cafeteria with caffeine-free diet coke that he had picked up for my attending (He asked, “Can you pick up 5025, I got paged when I was in line”), (3) a resident asking a question about how to sign off on a chart, (4) a self-interruption – she stopped her own flow of work and asked me “what tooth is this?” (I said incisor; she wanted the tooth’s number; the other resident working with her who was an

adult ED physician moonlighting in the pediatric ED said that he never memorized the numbers because he rarely saw patients with all their teeth) and (5) another resident wanting to tell her about a patient they had seen.

The result of these interruptions was that, very frequently, staff would lose their “train of thought” or forget to return to their original discussion or task (“Now, where were we?”). My observation that the ED is a context full of interruptions is in keeping with Chisholm and colleagues, who described the ED as “interrupt-driven” (Chisholm et al., 2000; Chisholm, Dornfeld, Nelson, & Cordell, 2001) and found, in one of their studies, an average of 30 interruptions (an event that briefly required the attention of the subject but did not require switching tasks) and 21 “breaks in task” (events that required the attention of a physician for greater than 10 seconds AND subsequently involved switching tasks) during an 180 minute observation period in the ED (Chisholm et al., 2000)!

Another theme that emerged from my observations was that ED healthcare providers recognized that updating was difficult and proactively took steps to facilitate updating. By proactive, I mean “acting in anticipation of future problem, needs, or changes” (*Merriam-Webster’s Collegiate Dictionary*, 2002). In particular, they deliberately revisited trajectories of care, they surfaced expectations to make it clearer when those expectations were being violated, and they enriched channels of communication. I focus on these three ways of facilitating updating because they touch on the three stages – scanning, interpreting, and acting – that link changes in the environment with changed behavior within organizations (Daft & Weick, 1984).

Revisiting trajectories of care: One of the challenges for updating in a context like the ED, where attention is such a scarce resource, was staying on top of all the data that was being generated or collected. ED healthcare providers worried about patients

“falling through the cracks” and regularly engaged in routines where they proactively revisited trajectories of care to determine if there had been any changes or developments that would necessitate revising the trajectory of care. By routines, I mean “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (Feldman & Pentland, 2003: 95). One example of a proactive updating routine recognized throughout the ED was called, “running the board⁷,” which involved various actors (usually physicians or nurses) running through the list of patients under the care of a particular physician or team to see whether each patient’s condition had changed, whether lab or x-ray tests were back, etc.

Here, one ED physician explained to me why regularly “running the board” was important for updating

Ideally, I have the residents run the board with me every couple of hours, so that nobody gets lost. It can happen. You can get lost in the shuffle and before you know it, four hours have elapsed and, you know, “What happened to that person in room six?”

Another ED physician talked about how he developed competency around proactively updating – here is an excerpt from my field notes:

He said that before [the hospital had an electronic whiteboard] he had trouble with seeing a new patient, and another one, and another one. Now, he steps back and reads the monitor (all patients belonging to one doctor have the same color scheme, i.e. today’s was white on green) and trained himself to go to the computer screen at regular intervals to ask, “What’s happening with this person?” “How about this person?” Also, now, compared to previously, he feels much

⁷ This phrase, “running the board” harkens back to the time when EDs had white dry-erase boards. At my dissertation site, they had recently converted from a white dry-erase board to a computerized “whiteboard.” Each staff member (physicians, nurses, etc) began each shift by signing into the electronic medical record system called EmStat, which is a commonly used ED information management system, and selected a color code that identified their patients that shift (for example, they could pick to have all their patient’s flagged with black text on a white fill background or white text on a blue background). This system, amongst other functions, provided an electronic listing of all patients in the ED, along with the patient’s assigned room number, test results that had been ordered (and the actual results when available), xray results (all images were digitized and could be seen on any monitor in the ED), etc.

more on top of labs i.e. used to have residents come up to him saying, this lab is back, but now he is saying, “Have you seen this glucose?”

It is important to note that the way that this proactive updating routine was enacted (i.e. the performative nature) varied somewhat from healthcare provider to healthcare provider but the principle underlying the routine (i.e. the ostensive nature) – in this case, to intermittently review the patient(s) under the care of the team – did not (Feldman & Pentland, 2003). At my dissertation site, I found that the “running the board” routine could be enacted by the attending physician going through the list of patients on his or her own and checking in with various other staff members to see what was going on with the patient. The routine was also often enacted by dyads (i.e. attending and one resident) or by groups (i.e. the whole team got together to go through the list).

ED staff also recognized that different types of patients called for different “thresholds” of updating. One ED physician said to me that he wondered if the “trigger” for updating ought to be set at a different threshold or point for each type of patient and suggested for acutely ill patients (for example, those who had been in a trauma), “You should be actively searching, you should be questioning. Asking, ‘Does anyone not agree with me?’” In contrast, for less acute patients, he said that “If you try to constantly update, you can drive yourself crazy”

Surfacing expectations: Another challenge in the ED was that patients often presented with symptoms that could be brought about by many different diseases – for example, the possible causes for joint pain and swelling in children ranges from benign (i.e. sprain or minor injury) to severe (i.e. infection in the joint or cancer). As such, ED staff had to sort through different possibilities as they interpreted and made sense of the

patient's symptoms. I noticed that the ED was a context where healthcare providers often made explicit their expectations about how they thought that patient's symptoms, diagnosis, and treatment would unfold. Put another way, there was a lot of "thinking aloud"⁸ about what ED healthcare providers would expect to find and what those findings might represent. For instance, I was shadowing an attending physician who was talking through the pros and cons for various diagnostic possibilities for a patient with petechiae (which are tiny round red spots from microscopic bleeding), "For a patient with petechiae.... What else could it be? Viral illness? Some kind of allergy? Kawasaki's? [a rare but serious disease that causes inflammation and damage to blood vessels, including those in the heart]... but we would need to have fever for Kawasaki's." One important consequence of this type of "thinking aloud" was that underlying thought processes were articulated, making it easier for the various healthcare providers working together to notice when things diverged from or converged with the expected plan.

There was another instance where ED staff were seeing a small boy of around four years old who presented with vomiting, fever, and headache but no diarrhea. Lab tests for two other common causes (strep throat and mono) of that constellation of symptoms were both negative. The ED attending explained to staff that if the patient developed diarrhea then the patient could be sent home with the presumed diagnosis of a viral illness but, if he did not develop diarrhea during the time he was being observed in the ED, then they would have to do more invasive diagnostic tests (to rule out more worrisome causes of vomiting, fever, and headache). One of the nurses, who knew that the other staff caring for the patient were wondering if the patient would develop

⁸ "Think-aloud" protocols are often used in usability studies particularly around human-computer interaction to determine why users are having problems. As well, there is preliminary research into using "think-aloud" protocols in research aimed at understanding diagnostic reasoning.

diarrhea, came bouncing up to the nursing station and announced that the patient had developed diarrhea. The staff literally did a happy dance, which they then qualified by saying that they weren't happy that the patient had diarrhea but they were happy to be able to make a relatively benign diagnosis.

In addition (and this may be related to the fact that my dissertation site was a teaching hospital), ED attendings would often ask the staff they were supervising to make predictions about what they would expect to see and what results would change the trajectory of care. For example, attending physicians posed questions like, "Should we order CBC or not? Would it change what we're going to do?" or "What should we do if the urine comes back pristine?" There were many instances during my field study when there was a gap between what was expected and what was found: for example, an x-ray that was ordered to document the absence of a fracture returned showing – much to the surprise of the ED staff – that a fracture was present; a lab test ordered as part of a panel and expected to come back as negative returned as positive, causing staff to reconsider their earlier diagnosis; during the resuscitation of a baby who had stopped breathing, repeated blood gases returned with worsening parameters, indicating that the baby was, in fact, getting sicker despite an improved clinical appearance. Given that the literature suggests that sensemaking is frequently re-activated when expectations are violated (Klein et al., 2005; Louis, 1980; Weick & Sutcliffe, 2007), this technique of surfacing expectations before data became available seems like a useful way to heighten sensitivity to violated expectations.

Communicating richly: One of the other challenges to updating in the ED was that the chaotic and noisy environment of the ED often made it difficult for healthcare

providers to communicate with each other and coordinate their actions. There were certain areas, like the trauma bays, where communication was especially problematic. For instance, during resuscitations in the trauma bay, it was common to have multiple simultaneous conversations in a small workspace, which meant that people were “talking over” one another, making it difficult to hear any one conversation. As well, during traumas, it was common for a single individual to be carrying on more than one conversation at a time – for example, with the patient and with another colleague – which made it difficult to follow what was happening in each conversation (as an everyday analogue, think of how difficult it is to follow the conversation when you are on the phone talking to one person and someone in the same room is also trying to have a conversation with you).

Just as healthcare providers developed behaviors to deal with the problem of scanning for relevant information and interpreting clues, they also engaged in behaviors intended to help coordinate their actions. Particularly when they were in environments – such as the trauma bay – that made communication difficult, healthcare providers tended to communicate richly, augmenting the information that they conveyed through speech with other modalities of communication, like gaze or gesture. For example, healthcare providers would often precisely identify the person to whom they were speaking – for instance, by using someone’s name or describing them (e.g., ‘you in the red shirt’) or by using gestures or gaze (i.e. pointing at them or looking at them) to get their attention. Alternatively, they might use gestures to demonstrate what they wanted the target of their communication to do. For example, one attending physician wanted to upgrade a trauma page so that more members of the trauma team would come to help – she communicated

this to the nurse who would send out the page by using a thumbs-up gesture on both hands, moving her hands upwards, as she said, “Upgrade the page – we need more helpers.”

In addition to enriching the information they were sending out to others, they also engaged in practices meant to ensure that their communication (and the information they were conveying) had been received correctly. For example, there was a policy in the ED of using “repeat-backs” for medications. This routine meant that when a verbal order for a medication was given to a team member, that team member had to repeat back the order and receive confirmation from the person who had given the order that they had heard it correctly. This practice of repeat-backs (sometimes called “read-back”) is common in healthcare and other high-hazard environments, like nuclear power (Joint Commission on Accreditation of Healthcare Organizations, 2008)

In extremely chaotic situations, ED healthcare providers seemed to employ one of two strategies: they either amplified their communication (i.e. spoke more loudly) or they quieted the situation. Asking for quiet seemed to be most legitimate when the requester was an individual in a position of power (i.e. the attending physician or the recording nurse). One of the well-respected attending physicians told me (and I had also observed this) that he routinely spoke more softly than normal during codes so that people would have to be quiet in order to hear him. As well, I would often hear staff use the phrase, “Only one person at a time” or “Let’s be quiet so that we can hear what x has to say. One recording nurse in particular would frequently say, “Let’s be quiet so we can hear our marching orders,” referring to the summary and instructions that the attending physician wanted to give to the team.

Social interactions that shape updating

The last major theme that emerged during this study was the fundamental role of social interactions for shaping updating. Patient care in the ED is, by its nature, complex interdependent work. It is very rare in the ED for a single healthcare provider to be able to re-evaluate a patient and change the trajectory of care on their own (even if they are the team leader, they might be able to order the change in trajectory but likely will not be able to carry out all the work to accomplish that change). This process of re-evaluating and possibly changing trajectory requires healthcare providers to articulate what they are thinking and then to navigate together, if necessary, toward a new understanding of the patient's condition. This process of revisiting and revising the trajectory of care requires coordination. There are numerous definitions of coordination (e.g., Crowston, 1997; Faraj & Xiao, 2006; Malone & Crowston, 1994; Rico, Sanchez-Manzanares, Gil, & Gibson, 2008) but, in the context of the ED, both coordination of activity and expertise are required. Therefore, when I use the term coordination, I conceive of coordination broadly and mean, "team-situated interactions aimed at managing resource and expertise dependencies" (Faraj & Lee, 2000: 1555).

Bids for attention: One of the main challenges of updating is focusing the attention of the team on an issue that may require revising the trajectory of care. In this section, I focus on a particular type of "team-situated interaction" that emerged as key for coordinating and shaping updating: bids for attention and the responses to those bids. A bid for attention is an attempt by a team member to share something they have noticed (or realized) with other members of the team, with the intent to have the team revisit (and possibly revise) the trajectory of patient care. Bids occurred when a team member

attempted to bring an issue of concern to the attention of the team and bids took many different forms. Bids for attention were usually verbal – for example, a team member might say, “The patient doesn’t seem to be responding to our treatment – can we take a step back and look at what’s going on?” – but bids could also include non-verbal gestures – for example, a team member might touch another team member on the arm to get their attention. Bids were more than information exchange; they served to shape meaning-making and to shape action. In my analysis, I found that bids varied in terms of their nature (sensemaking or sensegiving) and varied in terms of their explicitness (implicit or explicit). From my data, I developed a typology of bids (see Figure 4.3). I begin by defining terms and then illustrate each category with examples.

Bids varied around whether they were sensemaking or sensegiving. Remember that sensemaking occurs when “people organize to make sense of equivocal inputs and enact this sense back into the world to make that world more orderly” (Weick et al., 2005: 410). In contrast, recall that sensegiving is, “the process of trying to influence the sensemaking and meaning construction of others toward a preferred redefinition of organizational reality” (Gioia & Chittipeddi, 1991: 442). Please note that – in the context of complex interdependent work – bids for both sensemaking and sensegiving involve attempting to persuade others to pay attention. The difference between sensemaking and sensegiving bids is that sensemaking bids are an attempt to persuade other team members to recognize that there is a problem and to engage in sensemaking (i.e. revisit the trajectory of care and re-activate sensemaking), while sensegiving bids are an attempt to persuade other team members to revise the trajectory of care in a particular way (i.e.

convince other team members that the bidder's redefinition of reality is the most plausible one).

To illustrate, the conversation I related on p. 61 about interruptions – “Sorry to interrupt but her BP [blood pressure] is 68/40” – is an example of a sensemaking bid. This statement is a bid because the resident was deliberately bringing a new symptom to the attention of other team members (an alternate response, upon hearing the blood pressure was 68/40 might have been to dismiss it as a concern or to address the issue herself but, instead, she brought her concern back to the team). This statement is a sensemaking bid because the person bidding didn't put forward any particular plan for what was causing the patient's symptoms or what ought to be done about them but, instead, was engaging other team members (particularly her attending physician) in making sense of what they should do about the patient's trajectory of care, given this new symptom of low blood pressure.

Contrast that sensemaking bid with a sensegiving bid: during my observations, a nurse came up to where the physicians were working and said, “I'm worried this patient has appendicitis.” This statement is a bid because the nurse is attempting to persuade other team members to revisit and revise the trajectory of care. This statement is a sensegiving bid because the bidder has already developed a theory about the cause of the patient's symptoms and is attempting to influence others on the team to revise the trajectory of care in a particular direction (in this case, a concern that the patient has appendicitis means revising the trajectory of care and consulting the surgeons because appendicitis usually requires that the appendix be surgically removed).

Bids for attention also varied in terms of their explicitness, ranging from implicit to explicit. *Merriam-Webster's Collegiate Dictionary* (2002) defines explicit as “fully revealed or expressed without vagueness; leaving no question as to meaning or intent” and the *Merriam-Webster's Dictionary of Synonyms* (1984) clarifies that explicit, “implies such verbal plainness and distinctness that there is no need for inference and no room for difficulty in understanding.” Implicit is the antonym of explicit and is defined as “contained in the nature of something although not readily apparent.” By definition, implicit bids are more subtle and equivocal than explicit bids. To illustrate the difference, I draw on a common situation that occurs during resuscitations: a nurse thinks that the trajectory of care for a patient needs to be modified, specifically that a certain medication or treatment should be given to the patient but this nurse does not have the authority to order it him or herself so has to bring this concern to the team. An example of an explicit bid around this issue is, “I think this patient needs fluids” vs. an implicit bid, “Would you like to give fluids?”

Sometimes implicit and explicit bids were combined in sequence. Here is an illustration of how an ED nurse used an explicit sensemaking bid (“I think it is a stye”) followed by an implicit sensegiving bid (“Would you like a warm compress?”) to shape the revisiting and revising of a patient’s trajectory of care. This excerpt from my field notes comes from the case of a 23 month old female with a swollen eye. Various diagnoses for the swollen eye were being considered, including a bug bite that had gotten infected or a mild pre-septal cellulitis (an infection of the eyelid and surrounding tissue). The nurse went to clean the patient’s eye at the request of the ED physicians who were

having difficulty seeing the affected part of the eyelid (it was encrusted with pus). Here is an excerpt from my field notes:

When the ED nurse was done [cleaning the eye], she came back up to the area where the resident was sitting and working on the computer and said “It looks like a sty,” going on to explain that she’d cleaned up the eyelid and there was a hard round white area with purulent drainage. She (the nurse) then asked, “Would you like a warm compress?” [which is the appropriate treatment for a sty]. The resident went in to check and came back out saying that she agreed.

It was interesting that later, when the resident was telling the attending about the patient that she said (also), “I think it’s a sty” – instead of, for example, “The nurse noticed during the cleaning that it likely was a sty and I agree.”

Responses to bids: Earlier, I introduced a typology for classifying bids for attention. My study also suggests that there are different types of responses to bids (see Figure 4.3): positive responses, which build on the bid; neutral responses which either don’t acknowledge the bid or acknowledge the bid but don’t build upon it, and negative responses, which belittle or criticize the bid (and were extremely uncommon).

First, I share an excerpt from my field notes that shows multiple positive responses to bids for attention. This sequence comes from the ED video in the trauma bay.

A nine day old male was brought into the STS in respiratory arrest (i.e. not breathing). The team intubated the patient and, although the intubation initially went smoothly, soon afterward the O₂ saturations began falling precipitously. The trauma nurse in charge of airway noticed the O₂ sats were falling and began to verbalize what she was doing to fix the problem (i.e. “I’ve repositioned the head,” “I’ve checked MAP placement”). As the trauma nurse continued to make changes intended to improve the O₂ sats, the sats continued to fall. The attending said the number outloud: “55” (indicating that the O₂ sats were 55%), then said the number again and touched the airway nurse’s arm to get her attention. The resident, who was overhearing this conversation, turned to look at the O₂ sat, said “Is that real?” (referring to the O₂ sat reading), and immediately began to re-intubate the baby. Intubation was successful and O₂ sats started coming back up.

You will notice several interesting things about this example. First, the team is able to stay flexible and update the trajectory of care in an effective manner. Second, there are multiple bids for attention, in particular by the trauma nurse (who was narrating what she was doing to fix the problem of the low O₂ sats) and the attending physician (who built on the initial bid around the low O₂ and let the trauma nurse know, through saying “55” and by touching her arm that the trajectory continued to worsen). As well, the resident responded positively and immediately to the bid regarding the patient’s precipitously declining respiratory status and took action to change the trajectory of care (re-intubated the baby).

Often, however, bids for attention were not received as positively. If a bid for attention was ignored or belittled, the team member making the bid then either (1) persisted in their bidding attempt (i.e. re-bid), (2) potentially escalated their bid for attention, (3) attempted to strengthen their bid (i.e. recruited others on team to consider re-evaluation⁹), (4) performed an “end-run” and went above the team leader (this very rarely occurs) or (5) ceased bidding.

Next, I present an example where the healthcare provider making the bid for attention was initially rebuffed but persisted and eventually the bid for attention was granted. One of the best illustrations of this type of bid and response came during the pilot study for my dissertation and so – because it is such a good example – I include it here. I was observing a code on a middle-aged gentleman who had been brought into the ED in full arrest (no respirations or cardiac activity). The patient was originally in pulseless electrical activity (PEA), which means that although a cardiac rhythm is

⁹ Although I am unable to make this assertion from my field observation data, it may be that there is a “critical mass” of people within a team that need to agree on an issue for it to move forward.

detected on the monitor, the heart is not pumping efficiently enough to cause blood to circulate in the body (i.e. the patient is pulseless). The staff were following the standard Advanced Cardiac Life Support (ACLS) protocol for PEA. One of the important steps in a resuscitation is to stop intermittently to determine whether the patient is responding to treatment – in particular, whether the patient regains a pulse following the administration of various medications (and electrical shocks). It is important to determine whether the patient has a pulse because the management of a patient with and without a pulse is significantly different. In this case, the resident and attending physician felt that the patient had no pulse but one of the nurses was insistent that she could feel a pulse. The nurse kept saying, “Come over here, where I am standing, so you can feel the pulse here (pointed to the patient’s wrist).” The physicians complied with her request but still stated that the patient did not have a pulse. The nurse was convinced that the patient did have a pulse. Finally, the nurse requested that the resident go and get an ultrasound machine to visualize quickly at the bedside whether there was cardiac activity. Eventually, it was determined that the nurse was, in fact, correct and the patient had a weak but detectable peripheral pulse. However, the nurse needed to be very assertive in this situation to get the physicians to believe her assessment of the situation.

Lastly, sometimes bids for attention are unsuccessful. As mentioned previously, if the initial bid is ignored or dismissed, the healthcare provider must make the choice whether they wish to bid again. They can choose to persist or escalate their bid. But, eventually, if their bid does not elicit a positive response, then they may stop bidding for attention. At my dissertation site, there was a tragic example of an unsuccessful bid for attention. A young boy had been brought to the ED after sustaining significant injuries in

a motor vehicle accident. The staff caring for the patient were having difficulty gaining venous access (i.e. trouble placing a central IV). They were focused on gaining access and were paying less attention to other aspects of the patient's care. One of the residents on the patient care team kept saying, "I think this patient has a pelvic fracture" but was unable to gain the attention of other members on her team. As a result, the team did not revisit the diagnosis and the patient was not treated as if he had a pelvic fracture.

Unfortunately, the resident was correct – the patient did have a pelvic fracture, which is a medical emergency, requiring immediate surgical attention (fractures of big bones, such as the pelvis, can cause massive internal bleeding), and the patient died. This case is an example of successful individual updating but unsuccessful updating at the level of the trajectory of care.

Having presented my findings, I now turn to a discussion.

Discussion

In this study, I begin to sketch a portrait of updating as it was accomplished as part of the everyday work of healthcare providers. In doing so, I join a small but growing set of organizational researchers who study the processes that underpin the accomplishment of complex interdependent work as it occurs in organizational settings (e.g., Bechky, 2006; Faraj & Xiao, 2006; Klein et al., 2006; Maitlis, 2005; Maitlis & Lawrence, 2007; Obstfeld, 2001; Patriotta, 2003; Schulman et al., 2004; Weick & Roberts, 1993). My field study sets out to answer the research questions, "What does updating look like?" and "When and how does updating occur?" I found that updating was indeed part of the everyday work of healthcare providers but that updating was a complicated process, constrained by many of the contextual features of the ED.

In the ED, healthcare providers were aware of the importance of and challenges to updating and engaged in behaviors to proactively address these challenges, including deliberately revisiting the trajectory of care in order to monitor how the patient was doing, surfacing expectations in order to highlight when findings diverged from what had been anticipated, and communicating richly in order to facilitate communication and coordinate action. I found that social interactions – in the form of bids for attention – were a key way in which individual team members brought issues of concern around the patient’s trajectory of care to the attention of the team. In a context where attention was a scarce resource, social interactions that helped manage the flow of attention within the team by directing attention to areas of concern were vitally important. I also found that bids for attention were not straight-forward exchanges of information but, instead, were important pathways for sensemaking and sensegiving around the trajectory of care.

Contribution to the sensemaking literature

My study makes a number of contributions to the sensemaking literature. Historically, the sensemaking literature has primarily considered how (1) sensemaking around a particular set of circumstances is activated by jolts (Meyer, 1982), surprise (Louis, 1980), gaps (Cowan, 1986; Klein et al., 2005), or violated expectations (Weick & Sutcliffe, 2007), or (2) how sensemaking continues to unfold over time (Weick, 1995). There has been little discussion of the processes that enable actors to revisit and revise an already established trajectory of cognition and action.

I argue that updating is a particular aspect of sensemaking. While naïve sensemaking creates meaning out of chaos and establishes a trajectory of cognition and action (Weick et al., 2005), updating serves to refine the sense that has already been made

and revise actions and cognitions already in motion. There is an element of comparison and evaluation in updating that is absent from naïve sensemaking. To clarify, when I use the term naïve sensemaking, I do not mean that sensemaking has emerged from some sort of experiential vacuum – of course, the actors were engaged in a flow of activities from which they had to extract cues (Weick, 1995; Weick et al., 2005) – instead I mean naïve in the sense of new sensemaking that initiates a trajectory of cognition and action. For example, in the ED naïve sensemaking occurs when a patient presents for care and healthcare providers must determine the answers to the two sensemaking fundamental questions, “What’s the story” and “Now what do I do” (Weick et al., 2005: 410), and establish an initial trajectory of care for the patient; in contrast, updating involves revisiting that already established trajectory of care to determine whether revision is necessary. This distinction between naïve sensemaking and updating is important because there is evidence to suggest that once a trajectory of cognition and action is underway, it is extremely difficult to make changes (Davies, 1997; Keil, 2006; Salancik, 1977a).

Second, my study contributes to our understanding of how sensemaking and updating occur in a context with multiple sensemaking demands. The ED is a setting in which there are large amounts of available information, there are frequent interruptions and distractions, the “signal to noise” ratio is low, and the consequences for missing a diagnosis are profound (Eisenberg et al., 2005) and oftentimes the “amount of input to a system exceeds its processing capacity (Speier, Valacich, & Vessey, 1999),” which is one of the definitions of overload (Sutcliffe & Weick, 2008: 3). My findings highlight that caring for multiple patients simultaneously and, as a consequence, having to maintain multiple sensemaking threads is an additional burden on ED healthcare providers.

However, ED staff seem to recognize the challenges involved in processing large amounts of information and employ proactive behaviors to manage these challenges. In particular, their behaviors of regularly scanning the environment (revisiting the trajectory of care), facilitating interpretation (through surfacing expectations), and coordinating action (through rich communication), helps mitigate potential information and interpretation overload (Sutcliffe & Weick, 2008)

Third, my findings draw attention to the importance of considering how often team members influence the sensemaking of others on the team. Recall that sensegiving is defined as “the process of trying to influence the sensemaking and meaning construction of others toward a preferred redefinition of organizational reality” (Gioia & Chittipeddi, 1991: 442). Much of the literature on sensegiving has focused on top-down sensegiving – i.e. how leaders (Bartunek, Krim, Necochea, Humphries, & Wagner, 1999; Corley & Gioia, 2004; Gioia & Chittipeddi, 1991; Gioia & Thomas, 1996) or other individuals in positions of authority (i.e. middle managers, Balogun, 2003) shape the sensemaking of subordinates in the organization – but relatively little has been written about bottom-up or peer-peer sensegiving. Two other literatures also concerned with influence and persuasion – the literature on issue selling, which considers “individuals’ behaviors that are directed toward affecting others’ attention to and understanding of issues” (Dutton & Ashford, 1993: 398), and the literature on employee voice, which considers why and when employees proactively make suggestions for change (e.g, LePine & Van Dyne, 1998) – have examined when and how individual employees raise issues of concern about work to senior management. Whereas these literatures have focused more on understanding the individual-level factors and the organizational-level

factors that contribute to speaking up or remaining silent, my findings point toward the importance of studying the interactional moves that actually influence the meaning-making process of others.

Last, my findings suggest that updating is also shaped by the relative power or status of various members of the team. Conversations in the sensemaking literature are beginning to incorporate discussion around how power and status shapes the construction of meaning-making but this remains an under-explored area of sensemaking research (Weick et al., 2005: 418). Although my research is exploratory, my field study suggests that status shapes how team members make bids for attention. For example, team members engaging in explicit bids tended to be in roles that have been traditionally considered higher-status (i.e. physicians), whereas team members who engaged in implicit bids (particularly, implicit sensegiving bids) tended to be in roles that have traditionally been considered slightly lower in the healthcare status hierarchy (i.e. nurses). Healthcare is an extremely hierarchical setting, and this hierarchy often interferes with communication (Sutcliffe, Lewton, & Rosenthal, 2004). Future research is required to explore how issues of power and status influence how sensegiving and sensemaking bids are used to influence updating a patient's trajectory of care.

Contributions to the adaptation and coordination literature

My findings also contribute to the adaptation and coordination literatures. There is a long-standing focus in organizational research around how organizations and the actors within them respond to changes in their environment (Thompson, 1967). As work has become more complex, fast-paced, and interdependent, there has been a renewed focus on understanding how teams of individuals work together to adapt to changes and

manage unexpected events (e.g., Burke et al., 2006; Gittel, Seidner, & Wimbush, 2008a; Griffin et al., 2007; Kozlowski, Gully, Nason, & Smith, 1999; LePine, 1998; Pulakos et al., 2000; Waller, 1999; Waller et al., 2004; Weick & Sutcliffe, 2007). In a recent review of the literature on team adaptation, Burke et al. (2006) highlight the dearth of research on understanding the team processes associated with adaptation and call for more research on this topic.

My field study points out the difficulties of such adaptation and coordination in a context where attention is a scarce resource, where work is complex and interdependent, and where failures of adaptation and coordination are costly. I find that healthcare providers are able to direct the flow of attention within the team to issues of concern through bids for attention. These bids can be made in various ways, from implicit to explicit, and serve various purposes either by attempting to refocus the attention of the team on revisiting the trajectory of care and re-activating sensemaking (sensemaking bid) or by attempting to influence the revising of the trajectory of care in a particular direction (sensegiving bid). As well, I suggest a spectrum of responses to bids for attention, ranging from a positive response, in which other team members build upon the initial bid, to a negative response, where the other team members belittle or criticize the bid. I draw attention to the role of social interactions and propose these different types of bids for attention and the responses to those bids as the building blocks of updating.

As a brief, but important, aside: please note that my typology of bids and responses does not imply or assert appropriateness to either bids or responses, but merely categorizes actions in terms of the responses they elicit. By that I mean, I am not claiming that bids for attention are always appropriate or helpful (similar to the argument in the

voice literature that not all voice is salutary (Campbell, 2000; Grant & Ashford, 2007).

Likewise, I do not make the claim that a positive response to a bid is always appropriate – there may be circumstances in which a particular bid ought to be ignored or disregarded.

Findings from my field study suggest that updating is shaped through more or less generative sequences of interaction. I use the phrase “generative” to indicate that there were some patterns of interactions that seemed to generate more resources for meaning-making and for action. In bringing attention to the types of social interactions between team members that seem fundamental to updating, I draw on a long tradition of scholarly work that takes seriously the notion that the quality and frequency of interactions between teams members has important consequences for the ability of teams to detect errors and adapt to changing circumstances (Campbell, 1990; Gittell, Weinberg, Pfefferle, & Bishop, 2008b; Vogus, 2004; Waller, Uitdewilligen, & Zijlstra, forthcoming; Weick & Roberts, 1993; Weick et al., 1999; Weick et al., 2005). Concepts such as “heedful interrelating” or “respectful interacting” are frequently used to describe how actors create joint action or joint meaning, however few scholars have attempted to measure these constructs and link them to performance outcomes (for exceptions see, Gittell et al., 2008a; Vogus, 2004; Vogus & Sutcliffe, 2007). By identifying bids as building blocks for updating, I hope to be able to gain an empirical toe-hold and make progress in my lab study in developing a more nuanced understanding of how various types of interactions lead to more or less effective updating.

Last, my focus on interactions raises the question of whether interactional competence matters for adaptation and coordination and whether teams can learn how to become better at interacting with their environment and with each other. The phrase,

“interactional competence” is one that I developed as an analogue to other competencies, intending to point out the importance of developing competence around interacting. I use the term “interactional competence” instead of other terms, such as “relational coordination” – the “mutually reinforcing process of interaction between communication and relationships carried out for the purpose of task integration” (Gittell, 2002: 301) – or “relational competence,” because I cannot presume relationships between team members in the ED. The term “interactional competence,” it turns out, is also used by scholars who are interested in the social nature of language and interaction (Sanders, 2007; Young, 2000). In this usage, interactional competence captures the notion that (1) social realities are constructed through discourse, (2) the context that discourse takes place in matters, (3) discourse *is* social action, and (4) meaning is negotiated in interaction (Young, 2000). These characteristics, although from an entirely different field, speak to many of the dimensions of the competence around interactions that seems important from my field study.

Limitations and Future Research

There are several important limitations to this work. First, my data are collected in a dynamic high-risk setting where workers were acutely aware of both the importance of and challenges to updating and engaged in proactive behaviors to address these challenges. It may be that in less dynamic, less high-risk settings, workers may be less aware of the importance of updating and may exhibit different behaviors around updating. Although it is appropriate for exploratory inductive research to be conducted in an extreme setting (Glaser & Strauss, 1967), future research should focus on exploring the updating in other types of organizational settings to identify boundary conditions

related to updating. Second, I investigate updating at the level of analysis of team performance (the trajectory of care for the patient). In studying updating as it is accomplished as part of everyday work, there is also merit to understanding more deeply individual-level and organizational-level variables that affect the unfolding of updating, however my data does not speak to these. Third, field research is useful for creating a rich portrait of how updating is accomplished as part of everyday work but it is difficult to determine what patterns of interactions are more or less effective, for example, because there is no way for the researcher to know how well teams are doing in terms of their performance of updating (the referent around which they are updating is unknown). My next chapter addresses this concern and I study updating in the simulation lab, which allows for the evaluation of the efficacy of updating.

Figure 4.1

Updating Punctuating Trajectory of Care

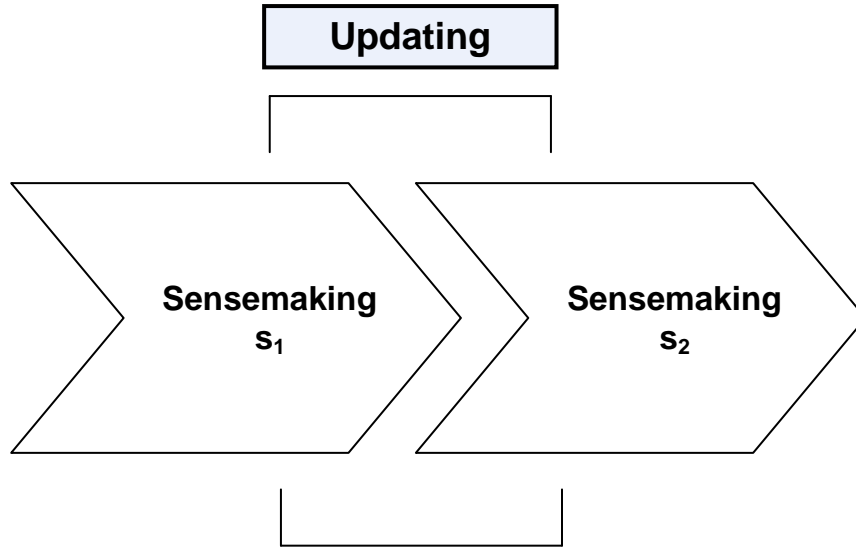


Figure 4.2

ED Layout

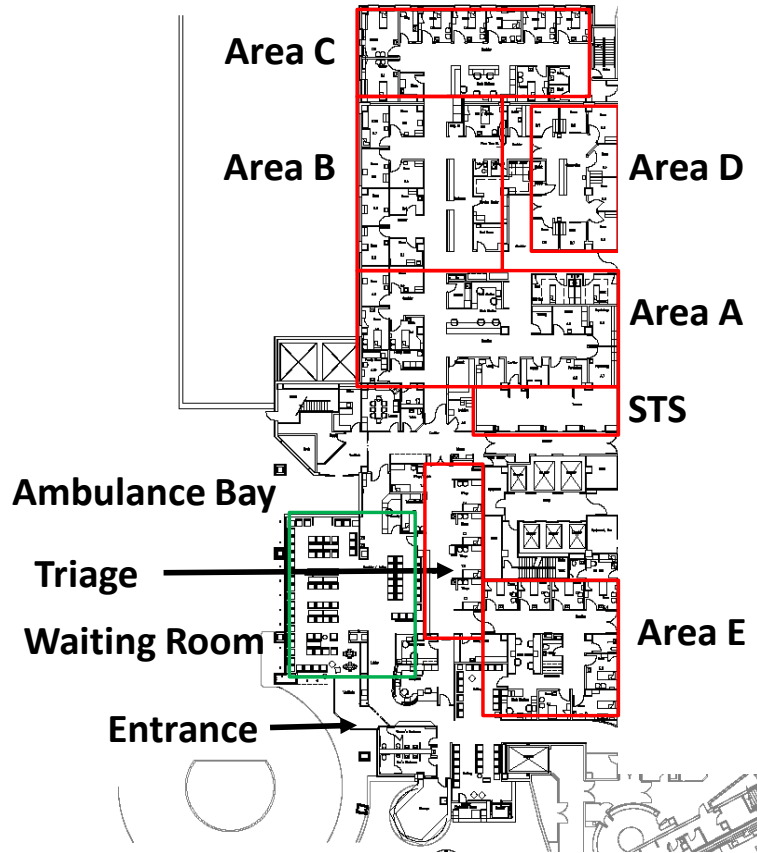
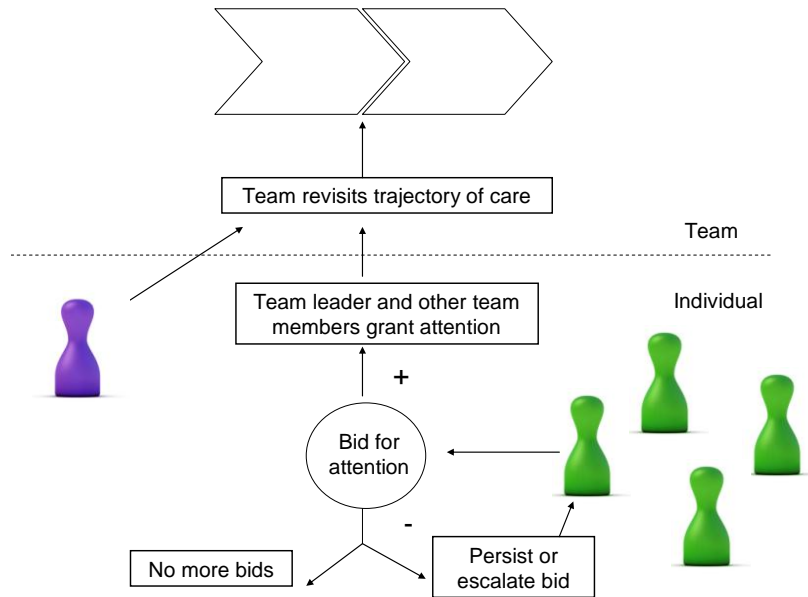


Figure 4.3

Patterns of Bids and Responses



Chapter 5

Updating in the Lab

In the previous chapter, I described how updating was accomplished as part of the everyday work of ED healthcare providers. From my field study, I recognized the importance of social interactions, particularly those that shaped the patient's unfolding trajectory of care. I developed theory around a certain type of social interaction – bids for attention and the responses to those bids – that seemed important for updating that I wanted to explore further. Building on the previous chapter, I continue my exploratory inductive study of updating and I expand upon the theoretical insights derived from my field work. To do so, I examine the same type of everyday work (caring for patients in crisis) performed by the same personnel (ED and Trauma Team healthcare providers) in a much more controlled setting: the simulation lab, which allows me to study updating as it unfolds in real-time as part of everyday work and also affords me the ability to assess the effectiveness of updating, something that is almost impossible to gauge in the field.

There have been a range of different types of studies to investigate updating (or lack thereof), including experiments (e.g., Davies, 1997; Staw, 1976), field studies (e.g., Bosk, 1979; Faraj & Xiao, 2006; Klein et al., 2005; Maitlis, 2005), interviews (e.g., Paget, 1988), mathematical models (e.g., Rudolph, Morrison, & Carroll, forthcoming), retrospective case studies (e.g., Vaughan, 1996; Weick, 1988; e.g., Weick, 1990, 1993; Weick & Sutcliffe, 2003), and simulation lab evaluations (e.g., LePine, 1998; Rudolph, 2003; Waller, 1999; Waller et al., 2004). Studying a process like updating is challenging

because it is difficult to anticipate when updating might occur (and be present to observe it), there is little opportunity to compare and contrast performance, and it is often difficult to know whether updating is being effective (the exception in the above list are the simulation lab studies). Therefore, in this study, I exploit the features of simulation lab to gain deeper insight into patterns of more and less effective updating. The simulation lab is a setting that replicates the type of work that healthcare providers are normally engaged in and mimics the experience that they have during their day to day work (e.g., Devitt, Kurrek, Cohen, & Cleave-Hogg, 2001) yet allows the researcher to also study the efficacy of updating.

The full potential of the simulation lab for studying updating (and related constructs, such as resilient organizing) has not yet been realized. In medicine, the original research in simulation labs focused on whether healthcare providers could learn how to do procedures in a lower-risk (i.e. lab) setting. There is a large body of evidence to support that simulation training can enhance task performance (e.g., Lee et al., 2003; McFetrich, 2006). It is only recently that the simulation lab has been used to investigate behaviors and interactions (i.e. safety organizing) and this type of research shows promise that experiences in the lab can influence clinical outcomes (e.g., Blum, Raemer, Carroll, Dufresne, & Cooper, 2005; Ruddy & Patterson, 2008; Shapiro et al., 2004). Likewise, in organizational research, past simulation studies have collected performance data related to updating and associated performance with either individual level traits and team composition (LePine, 1998) or with frequency and timing of behavior (Waller, 1999; Waller et al., 2004) but rarely with unfolding processes (exception, Rudolph, 2003). The simulation lab provides the opportunity to be able to compare and contrast the

performance of teams engaged in the same task and, since most simulations are also video-taped, provides data about the moment-to-moment interactions that facilitate updating (or any other process of interest).

In order to evaluate the effectiveness of updating, I studied how ED healthcare providers, who were participating in simulation training, updated their understanding around a patient's changing medical condition and trajectory of care. More specifically, I compared and contrasted the performance of 24 teams of ED healthcare providers who participated in the same asthma simulation scenario. In my study, there was significant variance in performance around updating – for example, the time it took teams to complete the same updating element of the simulation (time to notice and fix a key piece of broken equipment) ranged from less than 30 seconds to almost 16 minutes. Based on their performance, teams divided into roughly three groups. One third of the teams were able to accurately and quickly update their understanding of the situation (9/24 or 38% of teams). One third of the teams updated their understanding much more slowly and often required a clue from a confederate to accurately update (7/24 teams or 29%). The remaining third were unable to update on their own (8/24 or 33% of teams).

Based on my field work, I began this study with a set of assumptions around updating, particularly the importance of generative social interactions. In the lab, I found that social interactions were central to updating but, in addition, I found that two other types of interactions – specifically, interactions with the physical and cognitive environments that the individual team members are embedded in – were also key sites for emergent updating. I develop a model of updating as an interactional accomplishment and describe various pathways through which effective updating occurs. Ineffective

updating was a result of a cumulative failure of these interactions, particularly the social interactions, which formed the foundation for updating. I begin by situating my research questions within the literature, provide more details about the context and method for this study, and the present my findings and conclusions.

Observing updating

As work becomes more complex and interdependent, there is increasing interest in learning about how teams update their understanding of evolving situations (Griffin et al., 2007; Pulakos et al., 2000; Weick & Sutcliffe, 2007) In my dissertation, I explore two inter-related questions: (1) how and when does updating occur, and (3) what do patterns of more and less effective updating look like? These questions related to how updating is accomplished as part of complex interdependent work lie at the intersection of the sensemaking (e.g., Weick, 1995; Weick & Sutcliffe, 2007; Weick et al., 1999; Weick et al., 2005), the coordination literatures (e.g., Bechky, 2006; Faraj & Xiao, 2006; Rico et al., 2008), and the adaptive team performance literatures (e.g., Burke et al., 2006; LePine, 1998; LePine, 2003; LePine, 2005; Waller, 1999; Waller et al., 2004), While the sensemaking literature presumes that updating occurs, the mechanisms through which it occurs remain underspecified (Weick et al., 2005). While the coordination literature begins to unpack the mechanisms behind updating, there is little comparative research examining what factors influence performance outcomes for teams engaged in identical tasks. While the adaptive team performance literature explores some of the antecedents, consequences, and timing of updating, there remains much to be learned about the process of updating (Burke et al., 2006).

This study begins to address those gaps in the literature. The study of updating as part of the everyday work of ED and Trauma Team healthcare providers offers insight into how updating unfolds in a setting where updating is both challenging yet critically important. Patient care is work that involves significant time pressures, where the stakes are high, and where many resources that facilitate team performance (for example, team familiarity) cannot be assumed to be present (Eisenberg et al., 2005). Recall that I have described teams of ED healthcare providers as “temporary action teams” (Faraj & Xiao, 2006). The phrase, “temporary action teams” highlights two different yet important aspects of the care in the ED: the “action team” component consists of “highly skilled specialist teams cooperating in brief performance events that require improvisation in unpredictable circumstances” (Sundstrom et al., 1990: 121).

One of the main challenges of updating (although it is true of many other aspects of complex interdependent work) is coordinating trajectories of cognition and action between various team members. Please note that, like Burke et al (2006) and Kozlowski et al (1999), I think of team performance NOT as a global property of the team but as “the pattern of unique lower level team member and dyadic contributions that compile to characterize adaptive team performance (Kozlowski et al., 1999)” (Burke et al., 2006: 1192). Thus, I code for both individual actions as well as interactions between team members. Much of the literature on coordination and team performance assumes shared mental models (e.g., Klimoski & Mohammed, 1994; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000)¹⁰. However, in practice, this assumption of shared mental models may not be appropriate. Certainly, the assumption of a shared mental model

¹⁰ This idea of shared common understanding also goes by various other names, such transactive memory (Wegner, 1995), situation awareness (Endsley, 1996), collective mindfulness (Weick & Roberts, 1993), or distributed, group, or shared cognition (Cannon-Bowers & Salas, 2001)

cannot be made in the setting of the ED. Teams in the ED differ from teams in other settings, like the operating room (OR), in that team members are not necessarily familiar with each other and while they may share knowledge related to a patient's clinical care (i.e. what the standard asthma treatment is), they often lack knowledge of who knows what on any given team.

Of course, team members with common professional training will have similar vocabulary and understandings but, even among professionals, mental models are often not shared and communication between different types of professionals is frequently complicated, fraught with misunderstanding, and often requires methods to facilitate conversation across professional boundaries (Star & Griesemer, 1989; Stasser & Titus, 1985). More generally, members of teams do not have the ability – unless they have worked together for a long time and are able to anticipate each other's thoughts and actions – to know what other team members are thinking or feeling. Rather, team members rely on external signals – e.g., what other team members say and do, what markers of expertise team members display (Bunderson, 2003), and what roles they occupy (Meyerson, Weick, & Kramer, 1996) – as the basis for their own thoughts and action. In essence, team members must draw upon their observations of interactions within a particular situation to shape their own future cognitions and actions. While I acknowledge the importance of what occurs at the intra-individual level (i.e. individual cognition, affect, motivation, ability), the focus of my study is the accomplishment of complex interdependent work, visible in the actions and interactions (i.e. articulated thoughts, actions to change the trajectory of care of the patient, etc) that shape updating around a patient's trajectory of care.

Chapter-Specific Research Design and Methods

Research context

To learn more about patterns of effective and ineffective updating¹¹, I wanted to be able to evaluate healthcare providers caring for patients in a context that replicated their usual work and where I could begin to evaluate the quality of their updating. This study of my dissertation uses data from the medical simulation lab. There are many advantages to using the medical simulation lab as a context in which to study updating. In general, it is simpler to observe updating in the lab – the healthcare providers are only caring for one “patient” so the trajectory of action and cognition around diagnosis is clearer, the time the patient is under their care is much shorter, and - most important – the researcher knows *a priori* what is wrong with the patient so can study not only when updating is occurring but when updating is not occurring but should be.

My data for the lab chapter come from the same organization where I did my field work, Children’s Hospital, a Midwestern research and teaching hospital that is routinely ranked among the top 10 pediatric hospitals in the US. Specifically, the simulations took place at the Center for Simulation and Research on the Children’s Hospital campus. This facility is a high-fidelity simulation lab, by which I mean that it replicates the normal work environment of the healthcare providers as closely as possible. It has the following characteristics: (1) the simulation takes place in an exact replica of the trauma bay at Children’s Hospital, (2) the simulation scenarios are designed and performed by staff who are expert in both patient care and medical simulation (the Children’s Hospital

¹¹ While the construct of updating does not have performance written into it, the idea of effective updating does. This lab chapter, in contrast to my field chapter, talks about patterns of updating that are more or less effective, where effective is defined as “producing a desired effect or result” (*Merriam-Webster’s Collegiate Dictionary*, 2002).

Center for Simulation and Research staff are experienced ED physicians, nurses, and EMTs with specialized training in designing and running simulations), (3) the simulations use a robotic mannequin that enables two-way communication with the healthcare providers (i.e. healthcare providers can ask questions of the “patient” and the Children’s Hospital staff running the simulation can answer through a microphone embedded in the simulator), (4) the robotic patient is programmed to respond physiologically to interventions (medications/procedures, etc) the same way a human patient would and (5), the simulation lab is equipped with ceiling-mounted video cameras that record the simulations. It is important to also note that the simulation lab differs in at least significant way from the ED: in the simulation lab, staff are usually caring for only one patient at a time, which means that there are fewer interruptions and less potential for overload as fewer sensemaking threads are being maintained in the lab context.

Data sample and collection

For this study, I used an existing set of archival video data, which were collected over a period of approximately two and a half years (from July 2005 to March 2008). As part of ongoing evaluation, all ED and Trauma Team healthcare providers at Children’s Hospital participated in simulation training. ED and Trauma Team healthcare providers were randomly assigned to interdisciplinary teams (i.e. teams consisted of a combination of attending physicians, fellows, residents, nurses, respiratory therapists, EMTs, etc). The participants in the simulation interacted with simulation staff employees and were able to ask them for assistance. For instance, they could request test results (i.e. after a chest x-ray (CXR) was ordered in the simulation, a CXR film of a real patient with asthma was displayed) or a consultation (i.e. the team could request an “airway page” where someone

from anesthesiology would come to help). As well, simulation staff employees sometimes participated in the simulations, usually playing the role of the babysitter or parent of the child with asthma. Occasionally, especially if the team was small, one confederate would also participate as a member of the patient care team (there was no correlation between the presence of confederates and updating performance). Healthcare providers were aware that they were being videotaped and signed consent for the video to be used for teaching and educational purposes

In total, 26 teams of ED healthcare providers participated in simulation training. Each team spent two days together at the simulation lab and – out of 15 possible different simulation scenarios – participated in an average of six simulations (average = 6.08; median = 7; min = 3; max = 8). The set of simulations that each team participated in varied from team to team but teams shared multiple scenarios in common (complete list of simulation available upon request). Recall that one of my main goals for this study was to be able to contrast and compare the updating of various teams that were facing the same challenge to get a sense of what patterns of more or less effective updating looked like. Therefore, I chose to analyze the asthma simulations as all but one of the teams undergoing simulation training participated in this scenario (i.e. 25/26 teams; 24 asthma videos available for analysis¹²). In the asthma scenario, teams ranged in size from 4 to 8 people (mean size 6.54; SD 1.35). The teams were predominantly female – of the 157 participants, 130 (83%) were female and 27 (17%) were male. Figure 5.2 displays team composition, including number and gender of members – note that that while there were several (seven) all female teams, there were no all male teams.

¹² Note: one of the videos was only partially record (i.e. tape ends mid-way through simulation) so only 24 asthma videos were analyzed)

The simulation training was designed to minimize external influences on performance outcomes. In order to minimize order effects, the various simulations were presented in random order over the two-day period (the order of the asthma scenario in the sequence of scenarios was not significantly correlated with any key performance outcomes, $p = .05$; I also checked to see if teams that did more scenarios – i.e. 7 scenarios vs. 3 scenarios – performed better and there was no correlation). In order to preserve the element of surprise for those participating in the simulation training later on, healthcare providers also signed confidentiality agreements promising not to divulge their experiences in the lab with others (there was no correlation, $p = .05$ between when training took place and performance i.e. going later in the training cycle did not improve teams' performance).

In the simulation lab, the “patient” is programmed with a specific problem (or set of problems) that must be diagnosed and managed. In the asthma scenario, a small boy with a past history of asthma is brought to the ED with increasing difficulty breathing. As the scenario unfolds, the patient's asthma worsens to the point that he stops breathing. The team must appropriately diagnose and treat the patient's asthma, including assisting his breathing (when he is no longer able to breathe on his own). The additional challenge in this scenario is that one of the key pieces of equipment necessary to ventilate the patient is broken (the piece of equipment is called a bag valve mask and it is used to help the patient breathe). The team must figure out that the bag is broken and replace it, in addition to providing appropriate treatment for the patient's asthma. If they do not replace the bag, the patient cannot get oxygen and eventually goes into cardiac arrest and dies. This scenario has two very different types of updating that must occur for the team to

successfully complete the simulation: the first updating is around a commonly expected event (a patient's condition worsens i.e. he goes into respiratory arrest) and the second updating is around a much less common event (equipment failure).

Data analysis

Data analysis involved multiple steps. First, a timeline and transcript (of speech and action) was created for each video. Second, codes from the codebook that had been created during the field study were applied (for example, codes around bids for attention, both implicit and explicit; positive, neutral, and negative responses, etc). Third, in addition to applying codes that had already been derived, grounded theory analysis of this video provided additional codes (for example, codes around re-bidding – or bidding again – were added). Fourth, preliminary statistical analysis augmented my qualitative analysis to explore the relationship between key variables.

The 24 videos were all double coded: I coded all the videos and two research assistants coded half of the videos each. This double-coding technique is yet another strategy to increase the validity of my findings (Yin, 2003). The research assistants were blind to the hypotheses I had developed in my first study. Each video was transcribed in the following fashion: a timeline was constructed of key clinical events and updating moments and then a detailed transcript was created. The detailed transcript used a modified conversation analysis transcription of conversations and actions (refer to Appendix A for sample timeline). Coders identified the initial trajectory of care (in all cases, teams engaged in an asthma trajectory of care) and then noted all other possible diagnoses that were considered.

Coders also noted the time when certain key events took place (see Figure 5.3 for a list of key events i.e. when patient became unresponsive, when someone on the team noticed that patient was unresponsive, when someone on the team first took action to address unresponsive patient, when bagging the patient started, etc). As well, intervals were calculated for key updating moments. For example, in the asthma scenario, there were two updating intervals calculated: first, the interval of time required to update the trajectory of care around the change in the patient's respiratory status from respiratory distress to respiratory arrest (which was the length of time between when the patient became unresponsive and when the team provided respiratory support i.e. starting bagging the patient) and, second, the interval of time require to update that the trajectory of care in the face of equipment failure (which was the length of time between when the team started using the broken bag and when they finally replaced the broken bag with another bag). Note: some teams noticed the patient was having increased difficulty breathing and start preemptively assisting the patient's respirations with the bag - for these teams, the updating interval was entered as zero seconds.

After the annotated timelines had been created, I began to analyze the data using a modified grounded theory approach, following the guidelines suggested by Glaser and Strauss (1967) and Miles and Huberman (1984). Because this research was an extension of my research in the ED, I initially coded the data around the categories of social interaction (bids for attention) that had emerged from initial field work as important. I trained my research assistants on each element of the codebook (including showing them examples of each code) and had them practice coding until an acceptable level of inter-rater reliability was achieved (see Appendix B for coding instructions).

After the initial training, we continued to meet weekly to discuss any questions or concerns that had arisen and to resolve coding discrepancies. For example, at one of our coding meetings, we made the decision to also code bids from the patient or patient's family in addition to bids from other team members (an example of such a bid would be a patient's father, who asked staff, "Is he taking a nap?," after his son had gone into respiratory arrest and become unresponsive, an event unnoticed by staff). As their coding skills developed, I had the coders go back and re-code the video they had done early on, so that the transcripts were uniform in quality. Once all transcripts were finalized and coded, I calculated Cohen's (1960) Kappa statistic of inter-observer agreement, which represents the proportion of joint judgments (codes) in which there is agreement, after chance agreement is excluded. The Cohen's Kappa for all codes were above .8, which is considered by Landis and Koch (1977: 165) to be "almost perfect."

As I continued to read over the transcripts, I noticed that other forms of interaction were generative for updating, particularly interactions with the physical environment. Recall that in my field chapter, I introduced the phrase, "generative sequences of interactions" to highlight that some types of interactions were generative in the sense of enabling rather than inhibiting the meaning-making and action of the team. After further reading, it became apparent that updating emerged in interaction with either the physical, cognitive, or social environments (or some combination these) in which the actors were embedded. I re-coded the video transcripts to identify the type of interaction that led to updating. In addition to re-coding the 16 video transcripts where effective updating did occur, I also re-read and re-coded the transcripts where effective updating did not occur in order to develop an elaborated portrait of updating throughout the entire

sample of 24 teams. I constructed various ways of displaying the data, starting with a table and ending with a visual display in the form of a Venn diagram (discussed in detail in the findings section).

In trying to understand how updating emerged through interactions, I re-read literature and sought out new literature to inform my theorizing (Eisenhardt, 1989a), including the language and social interaction literatures (Drew, Raymond, & Weinberg, 2006; Glenn, LeBaron, & Mandelbaum, 2003), the behavioral research literatures (Bakeman & Gottman, 1997; Gottman & Roy, 1990), and the cognition in action and shared cognition literatures (Levesque, Wilson, & Wholey, 2001; Levine, Resnick, & Higgins, 1993; Michel, 2007; Weick & Roberts, 1993). I found the literature on multimodality (Goodwin et al., 2008 (under contract); Streeck & Mehus, 2004) to be the most useful and complete framework because it included all three components of the environment (physical, cognitive, and social). Using the multimodal interaction framework as a guide, I began my final analysis of the data to determine the pathway of action (i.e. individual revisiting and revising trajectory of care on own, individual initiating revisiting but including other team members in revising, collective revisiting and revising) through which updating unfolded (or did not).

I used QSR International's NVivo 8 to manage and analyze my qualitative data and SPSS 16 to analyze my quantitative data. NVivo 8 can manage text, audio, and video files and allows the researcher to create codes (known as "nodes") which can be either free-standing or hierarchically related to each other. In addition, this newest version of NVivo is much more powerful than previous versions and allows the researcher to sort

data by various attributes (i.e. you can run various queries, for example comparing high and low performing teams and how explicit or implicit bids were coded, etc)

Findings

Overview

Recall that my initial research questions were, “What does updating look like?” and “When and how does updating occur?” In order to answer these questions, I present my findings below beginning with a broad overview of the updating across the 24 teams. I then explore patterns of effective and ineffective updating, paying particular attention to the ways in which updating emerges in interaction and the pathways through which updating is accomplished.

Updating was accomplished more or less effectively in a wide variety of ways. Even though all the teams were participating in the same simulation, there was marked variation in the performance of updating between teams (see Figure 5.4 for a comparison of performance measures for all 24 teams). Remember that there were two major events in this scenario that require updating the patient’s trajectory of care: the first event was when the patient’s medical condition deteriorated – i.e. the patient transitioned from respiratory distress (significant trouble breathing) to respiratory arrest (no longer breathing) – and the second event was when a key piece of equipment failed (the piece of equipment used to ventilate the patient – the bag valve mask, sometimes called bag or bvm for short – did not work in this scenario, which meant that efforts to assist the patient with breathing were not effective). The first updating event seemed to be fairly straightforward for teams – in general, teams were able to update quickly around the change in respiratory status and provide assistance to the patient (mean time from when patient became unresponsive to when someone started bagging patient = 46 seconds). In

addition, a number of teams (8/24) anticipated ahead of time that the patient would go into respiratory arrest and started providing help by assisting the patient with breathing before the patient had actually arrested (note: anticipating changes in trajectory of care and proactively intervening was coded as effective updating).

However, the second major updating event – the broken bag – was associated with much more varied performance. Figure 5.5¹³, a histogram, shows the distribution of team performance related to the time it took to update the trajectory of care and replace the broken bag. The minimum amount of time to appropriately update around the broken bag and to replace it was 23 seconds and the maximum time was almost 16 minutes (15:38). The mean time for this updating interval was 6:13 minutes (shown on Figure 5.5 with a vertical red line) with a standard deviation of 4:25 minutes (shown on Figure 5.5 as a blue rectangle). Approximately one third of the teams (9/24 teams or 38%) were designated as high performers because they were able to accurately and quickly (i.e. time to update = less than mean) update around the central challenge of the simulation (the broken piece of equipment). For the high performers, the average time to fix the problem with the bag was 2:01 minutes, in contrast to the other teams, where the average was 8:52 minutes. One third of the teams updated their understanding much more slowly and often required a clue from a confederate to accurately update (7/24 teams or 29%). Of these seven teams, five of the teams updated on their own but did so much more slowly than the high performers (i.e. time to update ranged from 6:54 -15:38 minutes) and two of the teams required clues provided by a confederate to update (one team took 5:43 minutes, the other 12:53 minutes). In the remaining third (8/24 teams or 33%), the teams were

¹³ In Figure 5.4, time runs in 30 second increments along the x axis, and the columns represent the count of the number of teams that finished updating around the broken bag problem in that time frame.

never able to update on their own: for seven of the teams, the confederate provided the answer and one of the teams was never able to update (for this team, the simulation was finally halted by the simulation staff).

There are several things that are striking about the patterns of updating across all 24 teams. First, the range of variance with respect to the times required to update around the same issue is remarkable, which suggests that updating, while possible to accomplish, is certainly not straightforward, even amongst teams of experts. Second, the processes of revisiting and revising are sometimes distinct but, in cases where the trajectory of care is altered very quickly, these processes are difficult to tease apart. Third, certain types of updating challenges have considerably more variability than others. For example, as mentioned earlier, the interval to update around the first updating moment – the time between when the patient becomes unresponsive and when teams begin to bag the patient – is generally short and consistent across teams. This contrasts with the high variation around the second updating moment: updating around the broken bag. This raises the question of whether teams may be more skilled at updating around certain events than others. In this simulation, teams were more effective in updating around changes in clinical status (patient's symptoms worsening to the point where they stop breathing or their heart stops is a fairly routine occurrence in the ED) than in updating around the unexpected event of equipment failure (a much less common occurrence). Fourth, it took much longer (and there was much more variation around) for teams to raise the possibility of a broken bag than to test that possibility. Most teams mobilized quickly once someone on the team suggested that the bag might be faulty (this interval between the time when someone on the team first questioned whether the bag was working

correctly – marked by a green bar – to the time when the bag was changed – marked by a purple bar – tends to be fairly short¹⁴). This suggests that, for these teams, much of the challenge in updating is around generating plausible options to test rather than testing the possibilities.

Updating as an interactional achievement

I find that updating is a dynamic unfolding process, which punctuates the trajectory of care and emerges through interaction primarily between individual team members and their environment. By interaction, I mean, “mutual or reciprocal action or influence” (*Merriam-Webster’s Collegiate Dictionary*, 2002). A quick note of clarification about the use of interacting instead of enacting or relating: the term “enacting,” particularly in the sensemaking literature (Weick, 1995), is often used to describe how actors create aspects of their environment; I use the term “interact” to focus on the precise interplay between a particular actor and a particular aspect of a particular environment. As well, I use an interactional perspective rather than a relational perspective because, in this context, relationships may or may not exist.

The idea that organizing (and organizations) come about through interaction is not new; Weick’s (1979) seminal text highlighted the importance of taking serious the organizing processes – the “interlocked behaviors” – that constitute and re-constitute organizations. However, there still remains much to be learned about how organizing is accomplished moment-to-moment as part of everyday work (Barley & Kunda, 2001). For example, some of the early promising work on “double interacts,” which examines action, response, and re-action as a unit of organizing, has largely fallen out of favor with

¹⁴ There was one outlier team where this was not the case (time between first questioning the equipment and changing bag was 8:02 minutes) but for all the rest of the teams the time was relatively short (mean time = 25 seconds; min = 5 seconds second; max = 1:32 minutes).

organizational researchers (there are exceptions, e.g., Quinn & Dutton, 2005), although this fine-grained focus on interaction is thriving in other disciplines, like communications (e.g., Cooren & Fairhurst, 2004).

My data draw a rich portrait of updating as an interactional accomplishment (see Figure 5.1 for model). I have organized my findings into three sections: (1) sites of interacting, which describes the types of interaction through which updating occurs, (2) the actor or sets of actors who accomplish updating, which are connected by (3) the interlocked behaviors, specifically different types of double-interacts, that are more or less generative and are associated with effective and ineffective updating. My findings contribute to a broader understanding of the mechanisms that create transitions in understanding.

Sites of updating: My findings suggest that updating emerges as team members interact with various elements of their environment, specifically their *physical*, *cognitive*, and *social* environments. An example of an individual interacting with their physical environment would be a healthcare provider feeling the patient's chest to see if it's rising, looking at the monitor to see what the current oxygen saturation level is, or using a piece of equipment i.e. bag. An example of an individual interacting with their cognitive environment would be a healthcare provider interacting with cognitive tools such as a standard protocol for treating patient with a severe asthma attack, a standard PALS (Pediatric Advanced Life Support) protocol for treating patient with a heart rhythm shown on the monitor but no pulse for patient (this situation is known as PEA or pulseless electrical activity, I mention this because it comes up in some of the transcripts), or the "DOPE" mnemonic used to remember causes of problems with

ventilating patients; D = displacements; O = obstruction; P = pneumothorax; E = equipment failure). An example of an individual interaction with their social environment would be a healthcare provider interacting with another team member (e.g., a team member who isn't sure whether the patient is breathing might ask another team member to check to see if they can hear breath sounds). It is interesting to note that there were no instances in my data of updating emerging as an epiphany, disconnected from the interactions within the simulation. All of the updating could be traced to its roots in interaction with either the physical, cognitive, or social environments (or some combination of the three). Because the physical, social, and cognitive environments are inter-related, I have portrayed their relationship as a Venn diagram (see Figure 5.6).

Although I derived this framework from the analysis of my data, this three-part model is very much in keeping with the tradition of microethnography, which, as I have mentioned earlier, focuses on understanding situated human interaction as it unfolds over time, particularly with respect to how people use language, action, and tools to make sense together from moment to moment (Heath & Hindmarsh, 2002; Heath, Luff, & Knoblauch, 2004). Streeck and Mehus write, "Critical to all studies of cognitive practices conducted in a microethnographic vein is the analysis of the interplay of context, interactional participation, and cognitive tools" (2005: 390). It is unusual in organizational research to consider the interplay of all three types of environments. There are many streams of research that consider the interplay of two of these environments – for example, research on shared or distributed cognition is increasingly focusing on the interplay between the cognitive environments and social environments in which actors

are embedded (e.g., Gioia & Sims, 1986; Michel, 2007) – but the physical environment is often absent from consideration (obvious exceptions include research on artifacts, etc).

I use this model of updating emerging through interactions between an individual and their physical, cognitive, or social environment to organize and explain my findings. Of the total sample of 24 teams, 16 teams were able to update their understanding and replace the broken bag (14 teams on their own, at varying speeds, and 2 teams after clues given by confederates; see Table 5.1 for more details). For each team, the type of interaction that prompted updating was mapped onto the Venn diagram (see Figure 5.7). I identify each team in Figure 5.7 by their rank order number, corresponding to their relative performance (i.e. Team 1 updated the quickest – in 23 seconds – in contrast to Team 24, that took 15 minutes 38 seconds to update). Below, I begin to analyze the various dimensions of updating through interaction, beginning with the physical environment.

Updating in interaction with the physical environment: Updating often involves noticing changes in the environment (Weick et al., 2005). The updating challenge in the asthma scenario (a broken piece of equipment) by its very nature provides several physical cues to team members. First, when the valve in the bag is broken, the bag feels and sounds different during use than it normally does (as air leaks out it makes a sound and because the bag is not moving air, it is easier to compress the bag than it should be, especially in a patient with asthma). Second, because the bag is broken it is not able to properly ventilate the patient (i.e. the patient's chest does not rise when patient is being bagged). It follows that – in this case – individuals who are

physically closer to the cue might be able to more quickly update their understanding that the bag is broken. My data support this finding.

You will note in Figure 5.7 that the nine fastest teams all had updating emerge as the result of some type of interaction with the physical environment. In two cases (Teams 1 and 5), the individual who started bagging the patient (i.e. had the role of managing the patient's airway) felt there was something wrong with the bag and took action themselves to replace the broken bag. Below is an excerpt from the transcript for Team 1 which details the type of interaction with the physical environment that prompts updating - I include this transcript to illustrate that updating is emerging through a single individual interacting with a physical object (i.e. the man bagging the patient figures out that the bag is broken by the way that the bag feels). Of course, he is working in a context where others are present and he is interacting with them but the updating is contained within a single individual and emerges through interaction with the physical environment:

4:57: The man managing the airway (A) begins to bag patient. After he has given several breaths with the bag, he begins to look at the bag, to adjust the seal of the bag on the patient's mouth, to feel the connector between the mask and the bag. He keeps looking back and forth between the bag and the monitor. Two other team members, F and E, listen to patient's chest with stethoscope.

5:05: E says "Yeah, he's not breathing very well, at all." The team leader asks, "Are you assisting ventilation, Mike?" A doesn't not immediately respond as he is busy checking the equipment. A couple of seconds later he says, "Yes ma'am," and continues bagging the patient. He keeps looking at the bag and adjusting it.

5:16: A, speaking to one of the simulation coordinator, says "Can you get me that other bag?" Simulation leader hands him another bag and says "This one?" A says "Yeah, this bag doesn't seem to give me any chest rise. I don't know if it's the bag or not." B, another team member at the head of the bed, is helping A change the bag. A says to B, "You know what I'm saying? It just doesn't seem like it's going through the valve."

5:20: A removes the old bag, tossing it onto the equipment cart, and says, "We can pitch that, that's broken...Can you connect this one for me?" He changes the

bag and continues bagging patient. The simulation coordinator helps hook the tube up to the oxygen on the wall.

It is impressive to note that it only took 23 seconds for this individual to update around the fact that the bag wasn't working! The above description, although unfolding slightly faster, was typical of all cases where updating came about through interaction with the physical environment (in Table 5.1 you can see that the five fastest teams updated in under two minutes). When updating emerges through interaction with the physical environment, individual team members were using and manipulating the equipment (i.e. bagging the patient) and either responded to the "feel" of the bag (as in, "this doesn't feel right") or to the lack of chest rise, which bagging the patient should produce (as above). While there is a certain level of expertise required to know whether the bag "feels" right, the attention to whether the action (bagging) is producing the intended result (chest rise) is a more general clinical skill.

You will note that, in Figure 5.7, there are a number of teams where updating the trajectory of care for the patient began when a single individual expressed concerns about the equipment and then worked with colleagues to update their understanding. For example, Team 7 took just over a minute (from the moment they start bagging the patient to when they change the bag) to update the trajectory of care:

8:22: H is standing at head of bed and begins bagging the patient. She is really squeezing the bag hard (it's completely collapsed with each squeeze). She asks "Can somebody listen for breath sounds?" G (another team member) listens with her stethoscope to both sides of the patient's chest as H continues to bag.

8:31: A says, "Sats are still dropping...65...heart rate is 72 now"

8:36: G says "I have no breath sounds"

H: "No breath sounds?" Turns to look at monitor while continuing to bag patient.

G: “No breath sounds. Are we not in far enough?” B leans back and looks at where the ET tube crosses the patient’s lip and says “We’re in too deep.”

Team leader (A), H, and B all move physically closer toward the patient’s head and look at mouth. A asks, “How far are we down?”

8:50 H lets go of the bag and bends over to look at ET tube, G, without being asked, immediately takes over bagging patient and says, looking at the monitor, “Sats are dropping”

H says “We’re 20.... No, we’re 19 at the lip”.

A: Turning away from patient to look back at monitor, “Alright... at 65.” (talking about dropping O₂ sats)

H: “Should I pull this back?”

B: “Pull it back to 16 or 15”

9:00: H says she is pulling the tube back to 16 at the lip, A says “keep listening for breath sounds, keep listening for breath sounds,” B is taking stethoscope off (had it around her neck) saying, “I got it, I got it” and begins to listen to both sides of the patient’s chest.

H: “It’s at 16.” G continues to bag, and B listens to patient’s chest and says, “We still have no chest rise”

G: Keeps looking at bag and at the O₂ tubing and says, “I don’t feel like anything is moving through the bag.” H: “I know it doesn’t feel like that either. It sounds like there’s a leak.”

9:18: G hands the bag to H and says “you do this [meaning, you keep bagging the patient], I’m going to switch bags”, H continues to bag while G goes to wall and starts attaching tubes for new bag

The updating of the patient’s trajectory of care unfolded in the coordinated activity between A, B, G, and H but it is the moment when G mentioned her concern about the bag – “I don’t feel like anything is moving through the bag,” – which was immediately responded to and reinforced by H – “I know it doesn’t feel like that either. It sounds like there’s a leak,” – that preceded the change of the broken bag. It is interesting to note that here, as was the case in my field observations, bids and responses seem to progress in a sequence, moving from more implicit to more explicit and from sensemaking to sensegiving (see p. 72 for corresponding example from field study). In this case, the

initial sensemaking bid – “I don’t feel like anything is moving through the bag”- is met with an explicit sensegiving response – “It sounds as if there’s a leak.”

I found that moments such as these, where a concern about the trajectory of care was reinforced by someone else on the team, to be highly consequential. There were several teams that were unable to update, despite the fact that the person at the patient’s airway continually expressed concerns about how well the bag was working, however, no other team members ever engaged with them to work through their concern. This example illustrates how an individual’s concern about something they noticed while interacting with the physical environment (i.e. that the bag did not seem to be working properly) was reinforced through social interaction that built consensus around the nature of the problem (Streeck & Mehus, 2004).

Updating in interaction with the cognitive environment: Patient care – both in real life and in the simulator – is underpinned by a set of clinical protocols that are considered “best practices” for healthcare providers. Nowhere is care more formulaic than the ED, where healthcare providers have protocols to care for patients with a wide range of problems – patients who have been in accidents, who have irregular heartbeats, who are unconscious, who have stopped breathing, etc. These protocols function as a sort of “cognitive tool” and are shared in common amongst the various healthcare providers. For example, all healthcare providers in the ED are required to have PALS training, which teaches them a set of standard set of protocols to be used in various emergencies. In addition to protocols, healthcare providers also learn common sets of mnemonics meant to remind them of what diagnoses could be responsible for certain symptoms and many of these mnemonics are mentioned during the simulations (e.g., “ABCs” for

airway, breathing, and circulation and is the order in which healthcare providers are supposed to address the patient's problems i.e. fix airway first).

The most relevant mnemonic device in this scenario related to updating is the "DOPE" mnemonic, used to remember the causes of failures to ventilating the patient. Recall that D is displacement or dislodgement of the tube (checked by either xray to see tube placement, direct visualization of tube, or re-intubation); O is obstruction of tube or airway; P is pneumothorax (either seen on xray or detected clinically by putting a needle into each lung to see if air escapes; and E is equipment failure. For the two teams that were able to update only after a clue, it was the DOPE mnemonic that prompted updating. In one team, a single individual responded to the clue from the confederate and, in a fairly agitated fashion, went through the mnemonic. The transcript below shows the moment of updating through the interaction of one team member – the recording nurse – and the DOPE mnemonic:

16:38: The recording nurse at the foot of the bed (A) says, "We are spinning our wheels." Team leader agrees, "Yeah we don't have an airway." ICU consultant (who has just re-intubated the patient) says, "I gave you an airway." A says, "Yes, but we are not ventilating." ICU consultant says, "I think you had an airway before I came though, and that mnemonic I can't remember..."

17:00: A, speaking very loudly, bouncing up and down, and gesturing widely, begins to counting off each element of the mnemonic on her fingers, "DOPE! Dislodgement, we know it's in the right place. Obstruction...we've already checked that. Pneumothorax, so we have that?" Team says no. "Equipment failure? We've got equipment failure. Are we connected to the right oxygen tube?" Someone checks and determines yes.

17:20: Team leader grabs bag and asks, "Is this a problem?" Airway nurse starts checking the oxygen tubes again.

17:30: A has moved out of position at the table at the foot of the bed and has moved to the patient's bedside. She asks, "Are his leads on right?" She checks herself.

17:35: ICU consultant says feel free to change the equipment. Airway nurse reaches for a new bag.

17:48: A says, “Suction his tube!” They do.

17:55: The team finally changes the patient’s bag.

As you can see from the above example, the DOPE mnemonic serves as an important prompt to revising understanding and action. The recording nurse runs through the various elements of D-O-P and stops when she gets to E, having realized that the research team is having trouble with the patient is because of equipment failure. Although the clue (DOPE) was provided by a confederate, the nurse’s interaction with the mnemonic is a cognitive one – she asks and answers the question herself, “Equipment failure? We’ve got equipment failure.” There were only a few instances of this type of interaction resulting in updating but evidence from medicine and other fields suggests that various cognitive tools, such as mnemonics or checklists, help avoid common cognitive biases, such premature closure (ending search for diagnosis too early) or fixation error (getting focused on one particular choice without considering others) (Croskerry, 2003) and even improve communication across professional boundaries (Lingard et al., 2008).

Updating in interaction with the social environment: As you can see from Figure 5.7, updating often occurred as a result of interactions between individuals and their social environment. There were five teams where updating emerged as a result of their interactions with each other rather than with the physical or cognitive environments. These teams were able to accurately update their understanding that the bag was broken but it took them considerably longer than the top nine teams. These five teams were highly responsive to each other and, even though their interactions with other aspects of

their environment were sometimes flawed – i.e. thinking that the patient’s chest was moving with bagging when it was actually not – they were eventually able to update the trajectory of care through interactions with each other.

The issue of responsiveness to bids emerged as an important difference between high and low performing teams. By responsive, I mean “quick to react” (*Merriam-Webster’s Collegiate Dictionary*, 2002). High-performing teams tended to be more responsive to each other and low-performing teams tended to be less responsive (sometimes they completely ignored each other). To illustrate, in a responsive team when a team member made a bid for attention, the other members of the team would immediately and positively respond to the bid by acknowledging the bid had been made and then begin address the issue of concern raised in the bid. For example, a team member might say, “I don’t think the chest is rising” and – in a team where members were responsive to each other – other team members would start to look at the patient’s chest to see if it was rising, listen to the patient’s chest to see if there were breath sounds, and, if they confirmed that the patient’s chest wasn’t rising, they would start to problem solve together to figure out why the patient’s chest was not rising.

For many of these teams, the social interactions were the way in which they continued to generate possible causes for the patient’s symptoms – in essence, their interactions created an ongoing conversation about what could be happening. Some of the teams had correctly assessed the situation and were aware that the problem was that they couldn’t get enough air into the patient but, unfortunately, did not explore the possibility of an equipment failure as the cause of the patient’s symptoms until much later in the simulation. Instead, these teams explored other plausible diagnoses, such as making sure

there was no foreign body in the airway, making sure the patient did not have a pneumothorax (air outside the lung but still inside the chest cavity, which compresses the lung), and checking to make sure the tube was in the right place (either by extubating the patient and re-intubating or by ordering a chest x-ray to see tube placement).

This next section transcript illustrates how updating emerges through social interactions – due to the length of the transcript, I want to highlight several key points to attend to while reading it. First, for this particular segment of transcription, instead of the regular abbreviations for team members (assigning them to a letter of the alphabet, in clockwise order around the patient’s bed), I have written out the roles for each speaker – this is a very long transcript and using abbreviations for the speakers makes it difficult to keep track of what’s happening. Second, note that the length of the transcript is directly related to how long it takes to update through social interactions – as you can see in Table 5.1, social interactions tended to take the longest amount of time of all three categories (and are somewhat painful to watch and to read). Third, several key team members engage in most of the social interactions related to updating – pay particular attention to the interplay between the three physicians (one at the foot of the bed, another at the head of the bed, and the team leader). Fourth, note the disconnect between how they talk about the patient’s symptoms and what they do to test their hypotheses – the physician at the foot of the bed had correctly identified the problem as failure of mechanical ventilation at around 8:30 but did not actually test his hypothesis until 13:00 when the bag was changed. If this was a real patient and not a simulation, the almost five minute delay in acting to test a hypothesis would mean that the patient would have been profoundly brain-damaged, if not dead.

5:59: Airway nurse asks, “Can you do continuous epi.” Simulation coordinator responds that they can do it through the IV and not the airway. Meanwhile the team leader has been telling the physician at head of bed that they are going to need to look in the patient’s airway.

6:12: Physician at foot of bed, “Do we want to think about a terbutaline drip?” Team leader says, “Yep.” Physician at head of bed, “What have you got going on there? You have one IV over there right?”

6:32: Physician at foot of bed says, “So, pneumothorax is still a possibility.”

6:40: Med nurse asks how much ketamine she should give the patient. She has to repeat her question until someone responds.

6:49: Physician at head of bed announces, “We are not making his chest move much.” Physician at head of bed and the physician at foot of bed listen to the patient’s chest.

7:07: Physician at foot of bed asks the “babysitter” (played by the simulation coordinator) if the patient choked on anything. She says no, he was just on the couch getting his breathing treatments all day. Babysitter, “Is he going to be okay?” Physician at foot of bed, “We don’t know exactly what is going to happen. He’s having a really difficult time with his asthma and we are going to have to see where it goes from here.”

7:27: Med nurse asks the team, “Are we getting air in?” Physician at head of bed responds with, “Not much.”

7:39: Another physician at the head of the bed addresses team, “So we are ready to intubate? Everyone okay with intubating?” Everyone agrees. She begins intubation.

7:45: Med nurse asks, “Did you want to give him Atropine?” Team leader, “I am just seeing what his heart rate is doing first.” Physician at foot of bed says it won’t hurt him so they tell the med nurse she can give it and she does.

8:00: Physician who was trying to intubate the patient fails to accomplish this successfully. The airway nurse continues to bag the patient.

8:10: Team leader asks if the physician who had been intubating was able to see the chords – she says yes. Team leader says, “So it’s not his airway.” Physician at foot of bed mentions a foreign body. Team leader lists off what drugs and treatment they have given the patient.

8:37: Physician at foot of bed, “So it’s all going to be mechanical at this point. We need to get increased pressure and make sure he doesn’t have a pneumothorax.”

Physician who had tried intubating patient before tries again and successfully reintubates the patient.

8:49: Airway nurse, “Do you want to bag and I’ll tape him really quick?” Physician who had intubated the patient takes over bagging. Physician at head of bed, “I’ll listen while you bag.”

9:03: Physician at head of bed says there is still very little air movement.

9:10: Med nurse says to the team, “I don’t see his chest rising.”

9:15: Physician at head of bed again says, “Not much chest rise, not much air movement.” Physician at foot of bed asks if they can increase the pressure and use two hands to squeeze the bag. No one really responds.

9:30: Physician at head of bed asks if they should put in-line albuterol in, but then the airway nurse says she thought it can’t be done with this bag. The physician at foot of bed agrees. The physician at head of bed suggests that they put the patient on a ventilator to give him more pressure. But they don’t have a ventilator.

9:53: Team leader asks the simulation coordinator, “Can we get x-ray in?” Simulation coordinator, “X-ray can come in.”

10:04: The physician at head of bed says that they can’t get much pressure out of this bag and they can’t use an ambu bag. The physician at foot of bed and the physician at head of bed have a short inaudible but seemingly heated discussion. .

10:25: The physician at head of bed announces to the team that the CXR is normal and the ET tube is in the right place and no pneumothorax.

10:27: The physician at foot of bed says, “We are going to have to increase his PEEP¹⁵ a lot, can we increase PEEP with this?” Physician at head of bed says he needs more pressure. Airway nurse says she would love to give it.

10:47: The physician at head of bed and the physician at foot of bed suggest using the green bag now for better pressure. The airway nurse moves to get the green bag ready but then stops when the physician at head of bed asks her if she is bagging in albuterol and she says that she could, she needs more equipment. The airway nurse asks if they should just pretend to give it through the bag then.

11:35: Patient receives another epi through IV instead. Meanwhile the physician at foot of bed has been keeping up a constant stream of talking to the team leader, ignoring the team and the patient. He says he thinks it’s all about airway management at this point.

¹⁵ PEEP stands for “positive end-expiratory pressure,” which essentially is additional pressure above and beyond the regular atmospheric pressure; higher PEEP helps keep open the alveoli, which are the primary sites of air exchange in the lungs

12:03: Physician at head of bed asks the airway nurse, “We’re giving him albuterol through here?” The physician at foot of bed and the team leader says yeah they are.

12:10: The physician at foot of bed and the team leader tell the team that they think it’s time to switch bags as soon as they get the tube taped. Airway nurse asks, “So why are we switching the bags?” Team leader responds, “Because we are not able to ventilate him with this bag.” Physician at head of bed, “See if we can get better pressure out of it.” Airway nurse continues to tape the tube.

12:35: Physician at foot of bed asks if the medicine they have used so far is right because he can’t think of anything else to do. They talk about giving the patient a “drip” [referring to a terbutaline drip] for a while.

13:00: The airway nurse switches to the green bag.

13:10: The physician who had intubated the patient says, “He has a left radial pulse.” Physician at head of bed says, “Okay we’ve changed the bag, and you can give him a little bit of PEEP on your bag too.” Airway nurse pushes harder on the bag to increase the bag pressure.

13:25: Physician at foot of bed, “Pulses are all there. It’s all about his airway management.” Physician at head of bed agrees.

13:42: Physician at foot of bed asks if they have a pressure monitor that hooks up to the bag. Airway nurse announces that the patient’s stats are rising. Team turns to look at the monitor.

14:05: Physician at foot of bed, “Look at those stats coming up now. It looks like the bag is the answer.”

You can see from the transcript that as the team makes sense of the patient’s symptoms bids transition from those that are primarily sensemaking (i.e. “Are we getting any air in”) to those that are primarily sensegiving (“We’re going to have to increase his PEEP a lot...”). However, you will also note that the team was able to appropriately update the trajectory of action without appropriately updating their understanding of the situation (they did not realize that the bag was broken but, to be fair, a broken bag is providing no PEEP - see footnote 15 for explanation - so their discussion that they needed to increase

PEEP was technically accurate). In this example, even though the team was having trouble determining the cause of the patient's symptoms, they were generally responsive to each other and proceeded to rule in or rule out diagnoses that were raised as possible causes instead of getting fixated on one possible cause.

Actor or sets of actors who accomplish updating

I begin by unpacking some of the ways in which effective updating occurred by describing various patterns of actors or sets of actors who actually accomplished the updating. I then end this section by using the same interactional framework to categorize failures of updating, in the case of teams that were unable to update.

Figure 5.7 and Table 5.1 summarize the data for the 16 teams that were able to effectively update. I want to disentangle two subtle yet related processes: the first relates to the site of updating i.e. in interaction with which environment(s); the second relates to the actor or sets of actors who accomplish updating. In Figure 5.7 and Table 5.1, the team number represents the performance of the team (teams are listed in rank order, so Team 1 was the fastest). The position on the diagram in Figure 5.7 shows the site of updating; if a team is listed in one location with an arrow to another position, that means that the updating start through one type of interaction and then developed into another type. Teams that required a clue to update are coded in red and any updating that occurred as a result of an individual's insight is italicized. It is interesting to note that faster updating is more likely to emerge from interaction with the physical environment and is more likely to be accomplished by an individual actor acting alone whereas slower updating tends to be more social and results from collective action.

In my data, there were three distinct patterns in terms of how effective updating was accomplished: in the first pattern, a single individual accomplishes the updating entirely on their own (from revisiting the trajectory of care to revising it); in the second pattern, revisiting the trajectory of care is prompted by an individual but revising becomes a social process (may be limited to only one other individual but there is social interaction); in the third and final pattern, revisiting and revising emerge as a collective accomplishment through social interaction without any one individual being dominant (this is the rarest pattern). Below I explore in more detail each of the three patterns of how updating is accomplished.

Pattern 1 (individual action): You can see in Figure 5.7 the distribution of how updating was accomplished for each of the teams who successfully updated. Remember that the numbers in italics represent updating begins as a result of an individual's insight. For two teams, Team 1 and 5, the updating was entirely accomplished by an individual acting alone (recall the transcript for Team 1 when the person bagging the patient decides the bag is faulty). Individual updating as a result of physical interactions can result in very quick updating. Here is another example from Team 5 of how updating the trajectory of care occurs as a result of individual action. Note that in this transcript the airway nurse, who has been bagging the patient, has been checking the equipment but never voices a concern. As soon as the physician takes over bagging (i.e. after she's squeezed the bag once), she realizes it's broken and begins articulating her concern and then asks for a new bag:

5:00 The airway nurse (A) starts bagging the patient but the bed is still tipped in the upright (45 degree angle) position. The physician at the head of the bed (B) and A move to drop head of bed but it is stuck.

5:07 They are finally able to get the head of the bed down and A begins to bag the patient again. A, who has been trying to simultaneously hold the bag on the patient's face and move the bed, says, "Sorry, I'm trying to multi-task. This mask is too big. I need a small mask." Team leader (D) and B both say, "There should be a small mask behind you." B leaves and goes and gets a smaller mask from the med cart and hands it to the A. B then begins to listen to the patient's chest.

5:20 A takes off the old mask and puts the smaller mask onto the broken bag

5:27 A starts bagging the patient again. She bends over to look at mask and then straightens and looks behind her at the wall and the O₂ tubing. She continues to bag.

5:30 Meanwhile, D asks, "So is he breathing spontaneously?" B responds, "He is breathing spontaneously, but I guess he just has poor air movement." D, "Sats are very low." B says, "Rapid pulses....."

5:38 B, "Could we give him a sub-q epi?" D says, "I don't know how we give it sub-q" [referring to how you give it to the dummy] Simulation coordinator says, "You run it through the same system that's fine it'll go through sub-q" There's a pause and then A says, "Yes, I got it." [referring to getting the sub-q epi] and hands bag to B.

5:47 B squeezes the bag once, looks at it and says, "This is not functioning" D, "Is it hooked up? I mean is it hooked up to the oxygen?" B, "It doesn't feel right" A, "I felt the same way when I was bagging" D comes over, confirms that the bag was not hooked up to the O₂ and hooks it up. The sound of the O₂ running through the bag becomes audible. B says thank you to D and squeezes bag again and says, "It's still not..." A, "I thought the bag felt a little lax"

6:12 B, "I just don't like how the bag feels but.... This still... this is not.... This is not... I'm mean it's not... gimme that one" (she takes bag off with her right hand and uses it to point to other bag). A, "It's too little" B, "Well ... this one's not functioning."

6:47 They switch bags. B, "That feels better"

Pattern 1 seems to emerge from close interaction with the cue itself (in this case the broken bag) and when the actor is expert, confident in their assessment, and agentic, updating the trajectory of care can occur very quickly!

Pattern 2 (individual prompts social process): In this pattern, updating is accomplished through a set of actors. Sometimes, as in Pattern 1, an individual interacting with the bag first notices something is wrong and expresses their concern but, unlike Pattern 1, they do not immediately switch the bag on their own but instead engage others in discussion and build a consensus that the bag is not working properly before taking action to update the trajectory of care and change the bag. The social process can be limited to one additional person but the interaction produces the change in trajectory of care (i.e. changed bag). For example, there was one team – Team 6 – where the nurses at the airway began to take action on their own because the team leaders were not paying attention to their concerns. Pay particular attention in the following transcript to the fact that no other team members, including the physician at the head of the bed, respond to the two nurses' repeated voiced concerns about the patient until the very end of the transcript, when they have successfully identified and resolved the problem by replacing the bag:

8:55 Med nurse (A) is helping to hold the seal of the mask on the patient's face (a two-hand hold on seal – one on top and bottom of patient's mask). The airway nurse (C) starts squeezing bag one handed and looking at the O₂ tubing. A turns to look at tubing as well. A and C take the mask off the patient's face, feel inside of it, and then C starts pushing the mask back onto the connection with the bag and the A is checking the O₂ on the wall. C starts bagging again.

A moves back to patient's side says, "I don't think we're.. havin...(putting hands back on mask to hold seal) I think we're havin... I don't think the oxygen is working.

Simulation coordinator "He's 84%, guys"

Team leader at foot of bed (E) is watching what is happening at the head of the bed and turns away laughing

A: Is it working?

C, steps toward the med cart and touches the O₂ tank. "What if we use the

supplement?”

A to C, “Try that↓ (touching O₂ tank.) It’s empty.”

E, “Your oxygen tank is empty?”

A, “That one is. I don’t... we’re not...”

Simulation coordinator walking up to the bedside says, “You are on the wall.”

[meaning that the oxygen is being provided by the centralized supply mounted on the wall, not a freestanding oxygen tank]

A “We’re on the wall?”

C, “It’s not...”

9:40: Simulation coordinator points out that it’s best to listen over the speakers on the dummy. Physician at head of bed (B), who has been listening and silent for last while, “Yeah I’m not hearing squat.” E, “You aren’t hearing anything? He has no breath sounds?”

Meanwhile the A and C keep making adjustments to the equipment, adjusting the seal of the mask, keep looking at the O₂ tubing and flow monitor.

9:48: A (still holding seal) bends forward at waist to look at mask carefully. C continues to bag with left hand. A says, “I don’t think I don’t..... (feeling patient’s antecubital fossa for pulse). “LOOK.” C comes around to look

10:00: E asks B, “You don’t hear any breath sounds?” B, “I don’t hear anything.”

A says, “This isn’t working.” [referring to the bag]

C “How about that one?” and points to another bag on the med cart. A first picks up the green anesthetic bag and then picks up another larger clear ambubag, “This is awfully big” and turns back to patient. C says, “Just don’t squeeze it as hard” A puts new bag at patient’s head and goes to hook up the O₂ tubing. C has disconnected the original bag from the mask and is replacing the broken bag with the new one.

E says, “Let’s go ahead and intubate him. Do we have any intubation meds?”

10:31: B (who again hasn’t been speaking), “If I’m supposed to hear anything, I am not hearing anything.” E, “So bilaterally we’re not hearing breath sounds”

10:52: C, “Are we on?” Both A and C lean back to look at seal of mask on patient’s head. A, “Tilt it back a little” as they are tipping the patient’s chin up. They’ve switching the position of the bag so the A can bag and the C holds the seal. “Try now”

B, “Go ahead”

A squeezes bag

B, listening to patient’s chest, “I hear that”

You will note that, in this example, neither of the actors who modify the trajectory of care were the team leaders. Medicine is an extremely hierarchical field and so speaking up about a concern and – further – taking action to change the trajectory of care of a patient without consultation with the team leader is risky and potentially costly (Van Dyne, Ang, & Botero, 2003). However, in this study, I find that – most of the time – when individual actors have updated their own understanding, they take action to alter the trajectory of care for the patient’s benefit, regardless of whether they are directed to do so by their team leader. This finding of agency, even when potentially costly, may be a result of having a strong identification with and motivation to care for others (Ashford & Barton, 2007; Blatt, Christianson, Sutcliffe, & Rosenthal, 2006).

However, agentic action on the part of individuals who notice that something is wrong does not always happen – there was one rather heartbreaking video where the respiratory therapist at the airway suspected the bag was not working and made repeated bids to the team to address this issue – her bids were largely ignored and she did not take action on her own to change the bag. Eventually, the confederate on the team suggested changing the bag. Here is a synopsis of the bids she made before the confederate finally suggested changing the bag (at 7:40, giving the team plenty of time to respond to her bids),

3:44 Respiratory therapist (A): “This really is not working. The chest isn’t rising” (bid ignored)

4:08 A: “Yeah, this just really is not working.” (bid ignored)

4:35 A places her hand on the patient’s chest and looks at the team leader off-screen as she shakes her head and says even louder, “We are just really not... the chest is not rising, I’m pushing as hard as I can, the seal is good.” (bid ignored)

5:30: A says to a nurse at the head of the bed (B), “I have a good seal, great

position (nurse nods).” B asks her, “Could there be a blockage in his airway?” A checks if there is anything in the patient’s mouth and says to the team, “No, there’s nothing in there. He was talking.” [meaning, if he had a foreign body as the cause, he shouldn’t have been talking when he first arrived in the ED]. She is ignored.

5:40: A makes another plea to the team and gestures to the bag, “Should we fix this?”

This sequence of bids over the period of approximately two minutes shows an interesting progression from implicit sensemaking (i.e. “This really is not working”) to explicit sensegiving (“Should we fix this? – referring to replacing the broken bag) This observational data does not allow insight into the motivation that keeps the respiratory therapist from changing the bag, since she is clearly worried about it. However, research on voice and silence suggests that she could be motivated by either fear of negative perception or punishment or anticipated ineffectiveness (although in this case, the actual ineffectiveness of her bids is clearly demonstrated) (Van Dyne et al., 2003).

Harkening back to the subtle distinction that I am making between interaction and the environment and actors who accomplish updating, I want to provide a contrasting transcript from one of the teams that had updating emerge through social interactions around the physical environment (Teams 2-4), as opposed to a team where updating started with an individual noticing something wrong through interacting with the physical environment and then recruited other teammates (Teams 6-9). In the following transcript from Team 2, pay particular attention to the interaction between C and B as they make sense of the situation:

03:13 Nurse near airway (C) begins bagging patient

03:14 C checks tube and bag (*As soon as C starts bagging, she notices something is wrong. She starts at the mask, manually brings her hand down the tube and up to the O₂ connection in the wall, and turns the knob again to make sure it’s working

03:22 Team leader (B) to C: “Are you connected?”
03:25 C mentions that there is still a leak and checks O₂ connection

03:26 Recording nurse (E) to B: “Have we completed our head to toe?”
03:27 B to E: “No. We’re still on a...” B to C: “Wait, what’s going on?” (looks back to C, because C still seems to be having trouble bagging the patient)
03:33 D (another nurse) makes a bid, “I’m just wondering, he could have been stung by something”
03:34 B “...Could be, but we’ve given him sub-q epi and steroids” [meaning, even if he was stung, we’ve given the correct medications to treat that problem]

03:39 B to C: “What’s goin’ on?”
(The simulation coordinator, G, is quickly trying to change out the bag so that the new one C is about to grab works correctly.)
03:40 C tells B about bag problem (very softly): “Something’s wrong with the bag”
03:43 B: “Can we, uh, change bags?”
03:53 The med nurse (A) administers 30 mg ketamine
03:56 bag is changed, C: “That’s better” [referring to bagging the patient]

You can see in this transcript that B, the team leader, is highly attentive to what C, the airway nurse, is doing. B even interrupts a conversation with another team member, E, the recording nurse, to check back in and see why C is having trouble bagging the patient. Although C is the person closest to the broken bag, B plays an important role in bringing attention to the broken bag and suggests changing the bag.

Pattern 3 (collective action): The last way in which updating is accomplished is through collective action. As you can see from both Figure 5.7 and Table 5.1, this type of updating derives from social interaction and action (the two categories are highly overlapping). Social interactions can be both where updating emerges from and the pathway through which updating is accomplished. Here is an excerpt from Team 24, a team that worked very well together but just did not consider that a broken bag might be the cause of the patient’s symptoms:

19:00 Team leader (D) reads off most recent bloodwork (istat) information at the head of the bed at the airway position, one of the nurses by the patient’s bed (C) is at

the airway, pumping the bag, another nurse (B) is observing and notes they're still not moving any air, another nurse (A) is checking pulses

19:02 A "The tube's not working. I think you guys, we're only at 76%. and the C CO₂'s not picking up."

19:06 Recording nurse (E): "Wanna get another chest x-ray?"

19:07 D: "Yeah, can we get another chest x-ray please?"

19:18 voice offscreen: Initially, when we were bagging him, his sats were going up.

19:24 D: "I think after we took the tube out and bagged him up, his sats continued dropping. 76 is better than he was. He was 70 before."

19:37 One of the nurses (B) asks the team leader, physician (D): "Is there another way to get more air in? As far as like a ventilator? Or... will that be able to push more air in than the...."

19:41 D: (simultaneously with B): "More oxygen, we're trying to figure out what else to get into him... Is there anything else... Can we get him some..?"

20:05 D asks the simulation coordinator if they can get something to maximize the air pressure going into the patient: "If we maximized our PEEP in terms of ya know, if we say we maximized our PEEP"

20:09 D, asks simulation coordinator again: "So, can we get something to maximize the pressure?"

20:11 Simulation coordinator tells the team they can use a bigger bag or anything else provided to them

20:13 B: "A bigger bag?"

20:51 A reaches for the bigger bag to get ready and attach it to the patient

Note that this team does not identify the bag is broken but they are able to tell that the patient's symptoms continued to worsen, despite their interventions. And, like one of the previous teams who updated the trajectory through social interaction, they were able to appropriately update the trajectory of care without fully updating their understanding of the situation. You can see in the transcript above how they brainstorm ideas (B one of the nurses asking the question of whether there is a good way to get more air into the patient, a somewhat unusual question) and build off each other's ideas (D trying to figure out how to maximize the amount of air, and therefore the pressure – PEEP – going into the patient).

This process of reacting to how the patient is doing rather than focusing on a diagnosis is in keeping with Starbuck's assertion that good doctors pay careful attention to how patients respond to treatments. If a patient gets better, current treatments are heading in the right direction. But, current treatments often do not work, or they produce side-effects that require correction. The model of symptoms-diagnoses-treatments ignores the feedback loop from treatments to symptoms, whereas this feedback loop is the most important factor (Starbuck, 1993: 87). We can see in the transcript above that, through social interactions, the team is able to modify the treatment to improve the patient's symptoms, despite not knowing the actual diagnosis.

Interlocked behaviors associated with effective and ineffective updating:

Thus far, I have explored the sites of updating (different environments in which updating can occur) and the type of actors who accomplish updating. The last part of my process model of updating considers the interlocked behaviors – the nuts and bolts of organizing – that link these two elements (the environments and the actors). Weick (1979) and other process theorists suggest that interlocked behaviors form the building blocks that constitute organizing processes (and organizations). By interlocked behaviors, I mean that the behavior of one person is contingent on the behavior of another person (what A does shapes what B does). Organizational processes are made up of sequences of interlocked behaviors called “double-interacts” in which A acts, B responds to A's action, and A readjusts in response to B's response (Weick, 1979: 115). Given my interest in understanding how updating unfolds over time, double-interacts are a useful theoretical construct that turns a flow of activity into sequenced interdependent actions. My findings suggest that effective updating was associated with generative sequences of interlocked

behaviors and, conversely, that ineffective updating was associated with non-generative sequences of interlocked behaviors.

In this section, I focus on a particular type of interaction - recall that my field study alerted me to the importance of bids for attention, which I defined as, “the attempt of a team member to share something they have noticed (or realized) with other members of the team, with the intent to have the team revisit (and possibly revise) the trajectory of patient care.” There were important differences in the interlocked behaviors (bids and responses) of teams that were able to effectively update the trajectory of care and those that were not. I examined how bids and responses formed sequences of double-interacts, paying particular attention to the type and frequency of bids and the responses to those bids. In this section, I contribute a much richer description of the bids themselves and the responses (or lack of response) to those bids. I then draw upon data from teams that were not able to effectively update (8 teams) and compare and contrast the types of bids and responses between the high and low performing teams.

Bids and responses were coded by taking sequential interaction into account – words (or sequences of words, commonly called utterances in the conversation analysis tradition) or actions were not considered in isolation but as part of the unfolding sequence of activity. The video was coded for bids and responses in two ways: (1) by identifying a moment where updating occurred (for example, the bag was changed) and then moving backwards through the transcript to look for words and actions that seemed like explicit or implicit bids and (2) by identifying words or actions that expressed concern about the patient or the trajectory of care and then paying particular attention to what unfolded in response to the words or comments. An explicit bid – for example, “The patient is

unresponsive now, we need to bag him” – is an unambiguous attempt to draw the team’s attention to a change in the patient’s status that would require a change in the trajectory of care. Other bids were more ambiguous and subtle – for example, the comment, “His sats are falling” [referring to a decreasing trend in the patient’s oxygen saturation] – and were coded as implicit bids. The statement, “His sats are falling” taken in isolation could have many different meanings – it could just be a simple exchange of information but more often than not was the beginning of an unfolding sequence where the person bidding restated their observations or reframed them.

I need to begin my discussion of double-interacts with a caveat. Although this A-B-A sequence (which I will refer to as a *simple double-interact*) is considered a fundamental process of activity and influence, this classical A-B-A form was often altered in the context of complex interdependent work. The spirit of A-B-A (action, response to that action, and response to that response) persisted but oftentimes additional parties were involved (thus A-B-A was much more commonly A-B-C, a pattern I will refer to as a *compound double-interact*). For example, here is a *simple double-interact* (A-B-A sequence) following the bid the team leader makes to get the team to revisit the trajectory of care,

08:51 Team leader (D) addresses team, “OK, let’s think back, does anyone else have any thoughts about what other than asthma could be going on with this kid?”
08:56 One of the nurses (C) “An obstruction? Is it a possibility?”
08:59 D: “Let’s go ahead and take a look.”

This type of straightforward A-B-A sequence occurred very rarely in my transcripts. More common was a compound double-interact (A-B-C sequence), like this sequence when the patient became unresponsive:

3:03 Person standing at the airway (G): O₂ saturations 95%.... Jon... He's not responding (turns to look at end of bed)
One of the physicians (C): Jon, are you with us (starts doing a sternal rub [rubbing knuckles over the breastbone, which is painful and helps determine if the patient is responsive to painful stimuli even if not otherwise responsive])
Nurse nearest the intubation equipment (D): leaves the bedside and get the ET tube and stylet from the wall to anticipation of intubation

On the surface, it may not seem as if the above sequence qualifies as a double-interact but the bid, "Jon... he's not responding" is an explicit statement that the patient's condition has changed; the response by C, which builds on G's bid and checks to see if the patient will at least respond to pain helps determine that the patient is indeed completely unresponsive; and D's response to C's actions (confirming unresponsiveness) is to begin to assemble the equipment for intubation, which is the next appropriate step in the sequence of care. The transcripts are filled with these types of sequences of activities (and very rarely have simple double-interacts). If we consider that the accomplishment of complex interdependent knowledge work requires experts with shared cognitive models of patient care to coordinate their activity and take initiative (Klein et al., 2006), it makes sense that others would step in when their role was called for with little discussion of what needs to occur.

Teams that were able to effectively update were – with very rare exceptions – quite responsive to bids. Because they were so responsive to bids, there were only a few double-interact sequences per transcript regarding changes in trajectory of care, usually around when the patient changed status from respiratory difficulty (trouble breathing) to respiratory arrest (stopped breathing) and around when the bagging wasn't producing chest rise (as soon as the broken bag begins to be used to ventilate the patient). In contrast, teams that had ineffective updating had multiple bids but those bids were

usually ignored. For example, in the eight teams unable to update, there was an average of seven bids per team around the fact that the bagging isn't work (one team had 10) before the confederate provides the answer. Repeated bids were ignored. The sequence of failed bids presented below comes from a team who ignored multiple bids from the confederate and other team members (team members knew who the confederates were – they were running the simulation – so it seems extraordinary that they would ignore their bids, given that they were likely to know what was going on).

Bid 1 (confederate)

5:10 A (physician at head of bed, also confederate) "I don't think we're moving his chest very well. Can somebody listen for me" The two nurses at the head of the bed, B and C, listen. B says, "I heard some coarse wheezing otherwise I heard nothing" No one does anything else to pursue the issue of no chest rise. A does not say or do anything else during this sequence.

Bid 2 (confederate)

6:00 A: It doesn't feel like we're moving his chest can anyone see if he's got breath sounds. I can't see his chest rising" C listens, looks back at A and shakes head. A says, "No? Nothing?"

D: (who has moved closer to the patient (patient's left) and talking to A: "The other thing we have to worry about is obstruction. He came in with a good airway. Worried about airway ..." But then team gets distracted by giving intubation meds and possibility of obstruction is not followed up on.

Bid 3 (confederate)

7:57: A: "He just doesn't look like his chest is rising" F (med nurse) to D (team leader): "Yeah, I'm not hearing any air movement at all

8:07 → 8:32 patient intubated

8:12 F to D: "Yeah, I'm not hearing any air movement at all. Can someone listen for breath sounds and we should probably get an end tidal? But this idea was not pursued i.e. no end-tidal monitor applied.

Bid 4 (question from team leader to confederate)

9:56 Team leader, "What's our respiratory status?" A (confed) "no chest rise" Then team leader is asked by another nurse if she wants to give magnesium and the issue of no chest rise is not pursued.

Bids 5-7 (multiple actors)

11:03 B (nurse): "Do we hear breath sounds?"

11:05 “Let’s make sure everything is connected; I saw that go through the cords...we’ve got... (A trying to figure out why not ventilating)”
11:12 D (team leader): “Something else is going on here” (makes statement but then doesn’t act to follow up on anyone’s comments)
11:16 E: “Do we have the end tidal CO₂ hooked up?” “No not yet”
11:26 2nd epi given
11:32 A: “I’ve never had good chest rise with bagging him”
D: “No we didn’t, we had, he had chest rise when he came in we lost that”
11:40 B: “Is his trachea midline?” [if there is a tension pneumothorax, the trachea – windpipe – shifts to the side opposite the pneumothorax]
11:41 A: “Yeah his trachea’s midline. What’s that mnemonic for... um when you can’t ventilate?”
B: “DOPE”
A: “DOPE”
B: “Displacement of the tube...obstruction... tension pneumo...or the equipment (several people saying these together)
11:56 B: “You know I’m not getting...the reservoir bag’s not filling”
A (confed): “You wanna switch bags?”
D: “Switch bags, check equipment”
A: “Let’s do that... See if we get anywhere with that”
12:17 bag changed

In the transcript above there were multiple examples of the type of non-generative sequences of interactions that characterized teams with ineffective updating. In particular, the double-interacts were left *incomplete* i.e. a person makes a bid, their bid is usually acknowledged but not built upon (classified as a neutral response), and then no subsequent response occurred to complete the double-interact. In essence, many of the teams with ineffective updating ended up agreeing that the patient couldn’t breathe (and had rapidly decreasing O₂ sats) but did not pursue possible causes or provide remedies. Incomplete bids were highly problematic, in part because they halted the flow of interaction. This finding is reminiscent of other research that suggests that keeping organizations in action is key for coping with unexpected events (Christianson, Farkas, Sutcliffe, & Weick, 2008).

In contrast, teams that were able to effectively update their understanding were highly responsive to each other in all interactions, not just related to bids about the main updating challenges (patient going into respiratory arrest; broken equipment). As well, responsive teams made bids about other things they noticed and often used bids as part of identifying and correcting errors. Below is a transcript from a team engaged in conversation about why the heart rhythm looks odd (the leads that are placed on the patient's chest to monitor the electrical activity of the heart and show the heart tracing on the monitor had been accidentally reversed by the nurse applying the leads):

F (physician, team leader): "What... what lead are we lookin at? on that... It just looks funny to me

Everyone turns to look at the monitor

C (nurse at the head of the bed): That is lead 2↓

F: That is lead 2, it just looks odd to me

C?: Do you want another lead?

F: walks down to the recording nurse and looks at the printed-out copy of the heart tracing (EKG)

[pause – aside about family members and getting more history]

F: I'm not getting... his heart rate isn't matching, well, it's matching the pulse ox (points to the monitor) it's not matching the...

A (nurse at the airway) has been looking back and forth at the monitor and the patient's chest; at this point, A touches the top lead

F (seeing where A has pointed): Oh, that's what the problem is (realizes the leads, which are color coded, have been reversed; takes two left sided leads off and reverses them again so they are on correctly now)

B (another nurse): Was it the wrong one?

F: That makes sense, it wasn't...

B: That's my mistake for the day

F: That's OK, everyone has them

C: I'll agree with that.... (looking at monitor)

You can see in this transcript how responsive the team members are to each other, starting with the double-interacts between F, the team leader, and C, one of the nurses. It begins with F making a bid around one of the leads looking funny; C immediately

responds confirming that it is lead 2 on the monitor (the lead that is usually selected to display the heart tracing; different leads show different electrical wave forms); F restates her concern that the tracing looks odd, C asks if she wants to look at another lead. Even team members who aren't speaking, like A (nurse at the airway) participate and, in fact, A has figured out what has happened and communicates the answer wordlessly by just touching the lead, prompting F to realize that it's the wrong lead. The sequence ends with a double-interact between F and B, the nurse who had accidentally mis-applied the leads, talking about the mistake in a open and friendly way.

Although my sample of teams that were not able to effectively update is much smaller (8 teams vs. 16 who were able to update), there were different patterns of interaction between teams who were able to effectively update and those who were not. Aside from the findings mentioned above, ineffective teams also had more implicit bids (often very descriptive ones, "His sats are falling," "His chest isn't rising,") a higher total number of bids (because initial bids were frequently ignored, there were many more re-bids around the same issue), and many more incomplete double-interacts. In contrast, effective teams had sequences (usually of compound double-interacts) where they responded to each other bids, which tended to be more explicit (such as "This bag isn't working, please get me another one").

Failures of updating

Having discussed how updating is an interactional accomplishment, undertaken by various actors, through sequences of interlocked behaviors, I return to a discussion of patterns of ineffective updating. This data sample allows comparison between teams in terms of patterns of interactions. Given the nature of past research, we know considerably

more about patterns of ineffective updating (failures of updating) than patterns of effective updating. I analyze ineffective updating through the same interactional lens that I applied to effective updating (see Table 5.2 and Figure 5.8). In categorizing these types of ineffective interactions, I return to Daft and Weick's (1984) three stage model and have added (1) failures of scanning, (2) failures of interpretation, and (3) failures of action where appropriate to the diagram around sites of updating (Figure 5.8)

You will see in Table 5.2 and Figure 5.8 that, unlike the patterns of effective updating, I cannot easily place the eight teams who were unable to update on one specific area on the diagram. Rather, ineffective updating seems results from a cumulative failure of these interactions. Certainly, there can be ineffective interactions between actors and the physical environment (for example, mis-interpreting physical cues), actors and the social environment (for example, being unresponsive to bids for attention from other team members), and between actors and the cognitive environment (for example, not using clinical care algorithms appropriately).

In thinking about how ineffective updating comes about, Reason's "Swiss Cheese" model of errors is a useful analogy – in Reason's model, errors only occur if the gaps in each defensive layer line up so there is a path through (Reason, 1997: 9). Think back to some of the previous examples around effective updating – in the transcript on pp. 117-119, there were multiple failures, particularly failures of social interactions as multiple bids by the two nurses nearest the airway were being ignored. However, through interaction with the physical environment, the two nurses realized the cause of the problem and acted alone to fix the bag. In this case, individual action compensated for failed collective action. In contrast, in the transcript on p 110, there was a failure of

around the physical interaction with the bag – the airway nurse never realized it was broken – but, through conversation with each other, the team finally figured out how to alter the trajectory of care. For many teams, social interactions seemed to form the last “line of defense” in preventing failures of updating, highlighting the importance of this type of interaction.

Discussion

My lab study builds on my field study and, in addition to addressing an important controversy in the literature around whether and when updating occurs, begins to shed light on how updating is actually accomplished. I compared and contrasted the performance of 24 teams of ED healthcare providers who participated in the same asthma scenario in the medical simulation lab. Most of the teams were able to effectively update their understanding in the simulation but there was significant variation in performance (for example, the time it took teams to notice and fix a key piece of broken equipment – the key updating challenge in the simulation – ranged from less than 30 seconds to almost 16 minutes).

In the lab, I confirmed that social interactions were central to updating but, in addition, I found that two other types of interactions – specifically, interactions with the physical and cognitive environments that the individual team members are embedded in – were also key sites for emergent updating. I illustrated that updating was accomplished in a variety of ways and examined when updating was accomplished through an individual acting alone, an individual acting in concert with others, or as a result of collective action. Building on my previous field study, I developed a more fine-grained analysis of bids and responses, arguing that updating is accomplished through sequences of interlocked

behavior consisting of “double-interacts,” in which A acts, B responds to A’s action, and A readjusts in response to B’s response (Weick, 1979: 115). I found variation in interactional patterns between high and low performing teams and further developed the theoretical vocabulary and framework around the importance of bids for attention and responses. Last, I found that ineffective updating was a result of a cumulative failure of these interactions, particularly the social interactions, which formed the foundation for updating.

Contributions to sensemaking literature

In my lab study, my most important contribution is an empirical examination of how initial sensemaking and subsequent updating unfold in a setting where it is possible to evaluate the efficacy of sensemaking. I know of no other studies that have used this approach to study sensemaking (the closest related studies are Rudolph’s 2003 study of anesthesiology residents and fixation error and Waller’s research in simulators with nuclear power plant and air crews but the focus of these studies was not unfolding sensemaking). In addition, this is one of the few empirical examinations that considers processes related to sensemaking and links them to performance outcomes (Gittell et al., 2008a; Vogus, 2004; Vogus & Sutcliffe, 2007).

Second, my findings contribute to a more nuanced understanding of how updating is actually accomplished. There is a great deal of focus in sensemaking literature (as well as adaptation and coordination literature) around the creation of collective understanding and action (or lack thereof). I found that updating emerged through a variety of pathways, ranging from an individual acting alone to collective action, and that the effectiveness of updating around a trajectory of care was influenced both by the skill of individuals within

the team as well as the interactional competence of the team. There were many teams – particularly when updating occurred as a result of interacting with the physical environment – where individuals had key updating insights. Whether their insight was able to affect the trajectory of care of the patient depended on how confidently and persistently and agentically they made bids around and/or acted on that insight and how other team members responded to their bids.

Third, my findings provide empirical support for the theory that skilled social interactions form the foundation for coordinated adaptive accomplishment of complex interdependent work (Vogus, 2004; Weick & Roberts, 1993; Weick & Sutcliffe, 2007). This study highlights that interactional competence is an important component of effective updating. Teams that were able to update accurately and quickly also demonstrated interactional competence; effective updating emerged when team members noticed and responded to the bids of their colleagues and built upon those bids. In responding to bids, not being negative was not enough. I found that neutral responses were problematic; as was evidenced by some of the transcripts, bids need to build on each other and move the updating process forward. It was not helpful to have all the healthcare providers agree the patient couldn't breathe; they needed to figure out why.

In comparing the findings in my study related to updating to similar studies in the literature, I noticed an interesting pattern. I found that a fairly high percentage of teams were able to effectively update on their own (58%), which is in keeping with LePine's (1998) study, which found that 53% of teams were able to adapt, and is almost three times higher than Rudolph's (2003) finding that 19% of individual actors (embedded in a team of confederates) were able to effectively problem solve. This pattern that teams

seem to be more successful at updating than individuals is in keeping with Weick's observation that "having a partner makes social construction easier." (1993: 642).

However, it is important to also remember that, paradoxically, I found in my lab study that updating that occurred as the result of individual action happened more quickly than updating that resulted from more collective action (note trend in Table 5.1).

Fourth, in my field study, I developed a typology of bids and responses and differentiated between sensemaking and sensegiving bids. The findings from my lab study refined this typology. Further analyses of the transcripts suggested that the type of bids that actors make may change as an episode of sensemaking unfolds. In reviewing transcripts, the general pattern emerged of bids becoming more explicit over time and transitioning from sensemaking (attempting to have the team revisit the trajectory of care) to sensegiving (attempting to influence the revision of the trajectory of care in a particular directions). The emerging progression is illustrated in Figure 5.9. This observation that bids tend to evolve over time brings attention to the importance of studying sensemaking processes as they unfold over time and raises new empirical questions, such as whether there are windows of opportunity during sensemaking during which certain type of bids may be more or less effective.

Contributions to the adaptation and coordination literatures

The findings from my lab study contribute to the adaptation and coordination literatures by returning to fundamentals to understand a key process of organizing. Organizations and organizing are achieved through interaction (Weick, 1979). Although Weick (1979) put forth this theory of organizations as an interactional accomplishment thirty years ago, little research has been done on how sequential interactions contribute to

the coordination of activities (for exceptions, see Boden, 1994; Cooren & Fairhurst, 2004; Putnam & Cooren, 2004; Quinn & Dutton, 2005) . My dissertation highlights the importance of considering sequential interactions as part of everyday work. Using this focus, I find that updating is not an abstract intrapersonal cognitive phenomenon but, as part of complex interdependent work, updating is a concrete accomplishment, which occurs through interaction.

Even more than that, this study highlights the importance of studying interaction broadly construed. Much of the historical research on interaction has focused on person-person interaction but of course individuals interact with their physical environment as well as their social environment. Scholars in communication, among other fields, have begun to investigate how individuals interact with inanimate objects, like texts (Putnam & Cooren, 2004). More recently, scholars have begun to carve out a new field – microethnography – that examines how individuals interact simultaneously with the physical, cognitive, and social environments (e.g., Goodwin et al., 2008 (under contract); Heath & Hindmarsh, 2002; Streeck & Mehus, 2004).

Limitations and Future Research

There are several limitations of this work that are important to mention. First, I joined a simulation program already underway and there was information that would have been helpful to my analysis that was simply not available to me (for example, measures of expertise or measures of team familiarity). This missing data makes it difficult to fully account for alternative explanations around patterns of effective and ineffective updating – instead, in this study, I describe processes and associations rather than explain variance (Mohr, 1982). Second, because my data are observational, I cannot

shed light on the intrapersonal processes that may shape updating (for example, past research suggests that the conscientiousness and cognitive ability of individual team members influences team adaptation; LePine, 1998). It would be interesting when researchers undertake future studies of updating to gather data in order to be able to evaluate the influence of intrapersonal factors as well as other team or organizational-level factors, such as team familiarity, on updating.

Third, this study compares the performance of 24 teams from the same organization. While I am able to study how updating varies across teams within this one organization, I do not examine how updating varies across organizations. It is important to note that the very features that make studying updating appealing in this setting – updating occurring in a short time-frame, updating in a high risk setting where updating is of paramount importance – may also limit the generalizability of my findings to less dynamic and less high-risk settings. As well, the type of organization – a teaching hospital – may have unique attributes that shape how updating is accomplished. Teaching hospitals, by their nature, are fundamentally organizations where teaching and learning are prized. This learning orientation may influence interactional norms – for example, how acceptable it is to revisit and possibly revise a trajectory of care – that would not characterize other healthcare settings, like community hospitals. Future research of updating in other settings may help identify how other organizational contexts shape updating.

Table 5.1**Comparison of Effective Updating**

Team #	Time to update	Site of updating	Actor(s)
1	0:23	Physical	Individual acts alone
2	0:32	Physical/Social	Individual prompts social
3	0:34	Physical/Social	Individual prompts social
4	1:07	Physical/Social	Individual prompts social
5	1:47	Physical	Individual acts alone
6	3:07	Physical	Individual prompts social
7	3:21	Physical	Individual prompts social
8	3:27	Physical	Individual prompts social
9	3:53	Physical	Individual prompts social
13	5:43	Cognitive/Social	Collective
14	6:54	Social	Individual prompts social
15	7:20	Social	Collective
18	7:42	Social	Collective
20	12:28	Social	Collective
22	12:53	Cognitive	Individual prompts social
24	15:38	Social	Collective

Table 5.2**Comparison of Ineffective Updating**

Team #	Time to update	Primary sites of failures of updating
10	4:28*	Individual updating occurred but no updating of trajectory of care Failure of action (including individual action)
11	4:41*	Failure of action
12	5:00*	Failure of interpretation (misattribute cause of symptoms) Failure of action
16	7:20*	Failure of action
17	7:24*	Failure of interpretation (mis-interpret physical cues) Failure of action
19	8:18*	Failure of action
21	12:34*	Failure of scanning Failure of action
23	12:55**	Failure of scanning Failure of interpretation Failure of action (get fixated on algorithm)

* time confederate gives answer and updates trajectory of care

** time simulation halted

Figure 5.1
Process Model of Updating

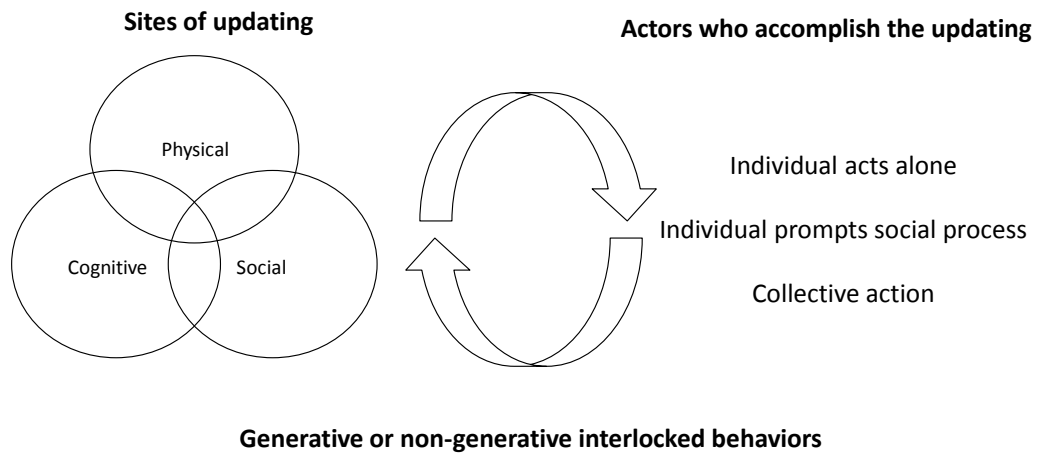


Figure 5.2

Composition of Team in Terms of Size and Gender

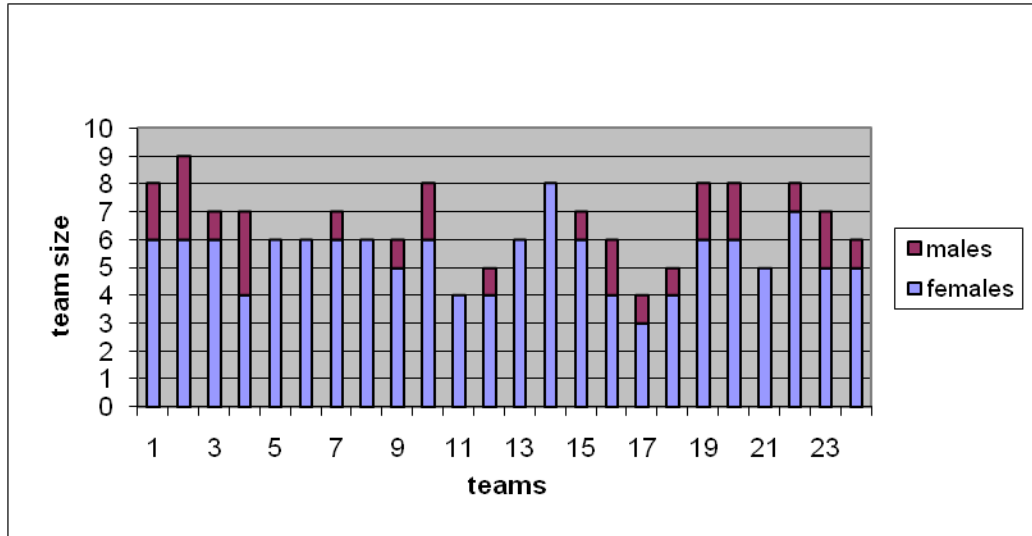
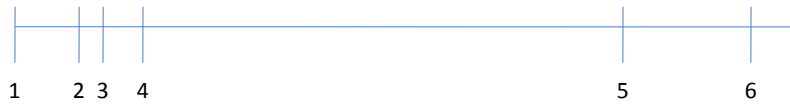


Figure 5.3

Key Times in Scenarios and Time Intervals



1. Time when patient stops being responsive (i.e. last time talking or moaning)
2. Time when someone on team first mentions that the patient is unresponsive
3. Time when someone on team begins to take action to deal with unresponsive patient (describe what's happening)
4. Time when someone starts bagging patient
5. Time when bag first questioned or changing bag is first mentioned as solution to the problem of ventilating the patient
6. Time when bag actually changed

Intervals:

- a. fix_unresp: time required to update trajectory of care around unresponsive patient (time 4 – time 1)
- b. fix_bag: time required to update trajectory of care around broken bag valve mask (time 6 – time 4)

Figure 5.4

Comparison of Updating Performance of All Teams

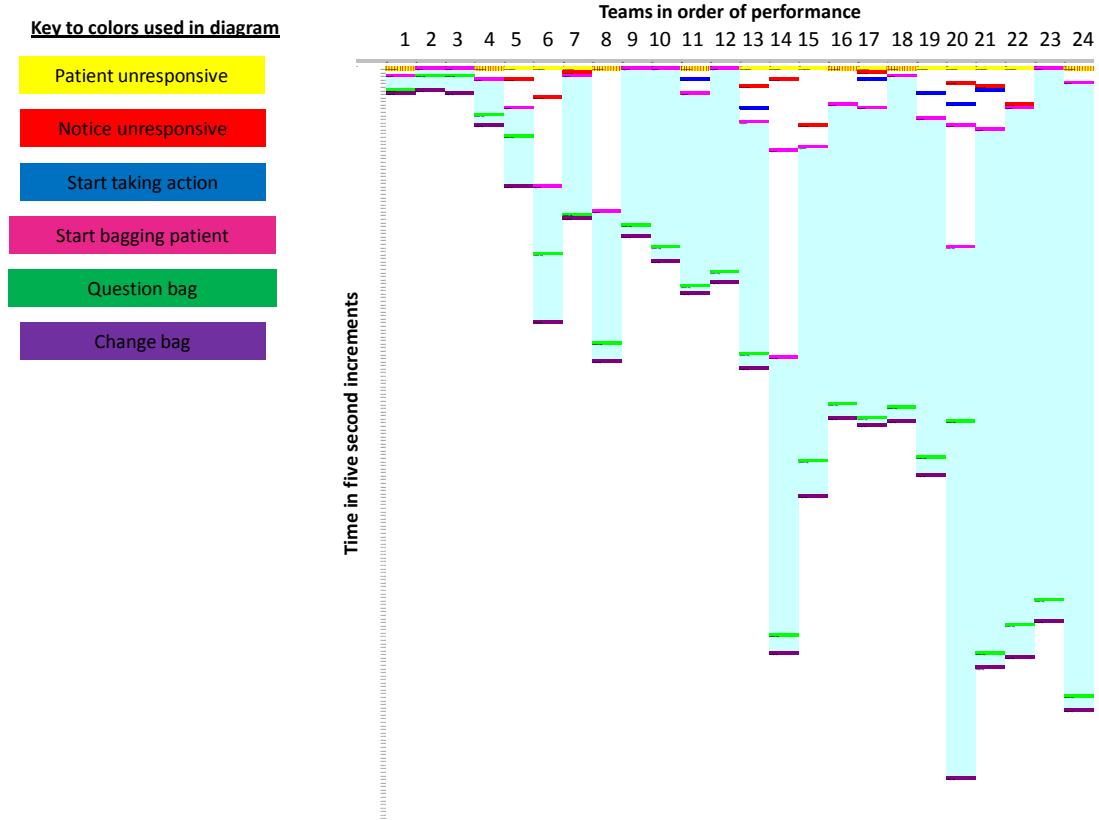
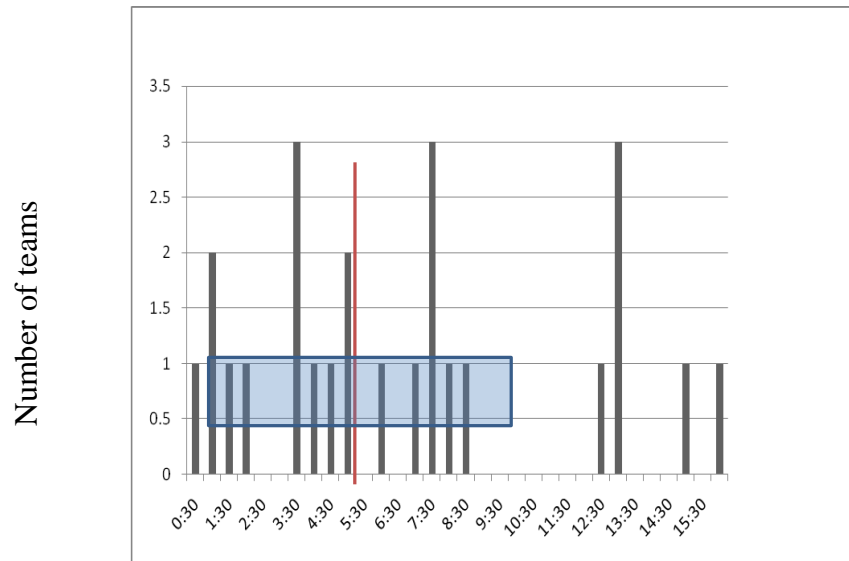


Figure 5.5

Frequencies of Time Required for Updating



Time intervals (in thirty second increments)

Mean = 6.13 min
SD +/- 4.25 mins

Figure 5.6

Relationship Between Environments

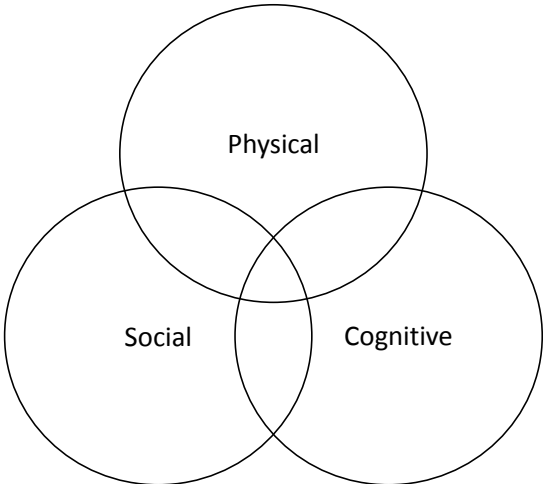
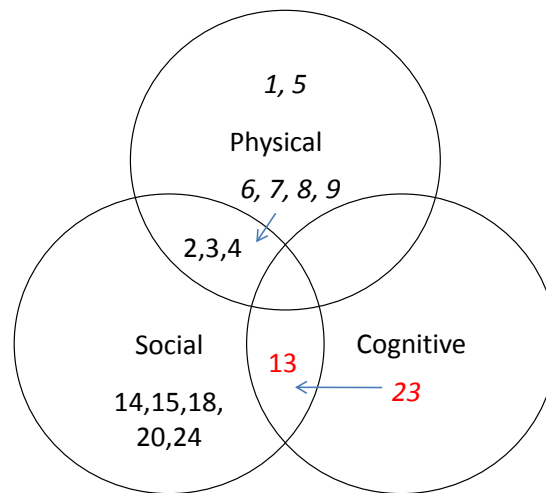


Figure 5.7

When and How Updating is Accomplished

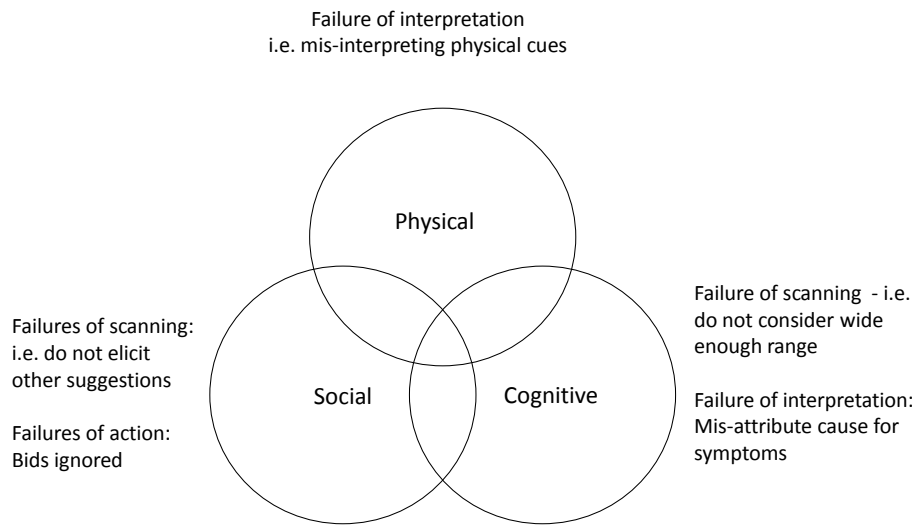


16/24 teams were able to effectively update
- 14 teams on their own (at varying speeds) and
- 2 teams after clues were given (in red).

Updating that begins as the result of an individual's insight is italicized

Figure 5.8

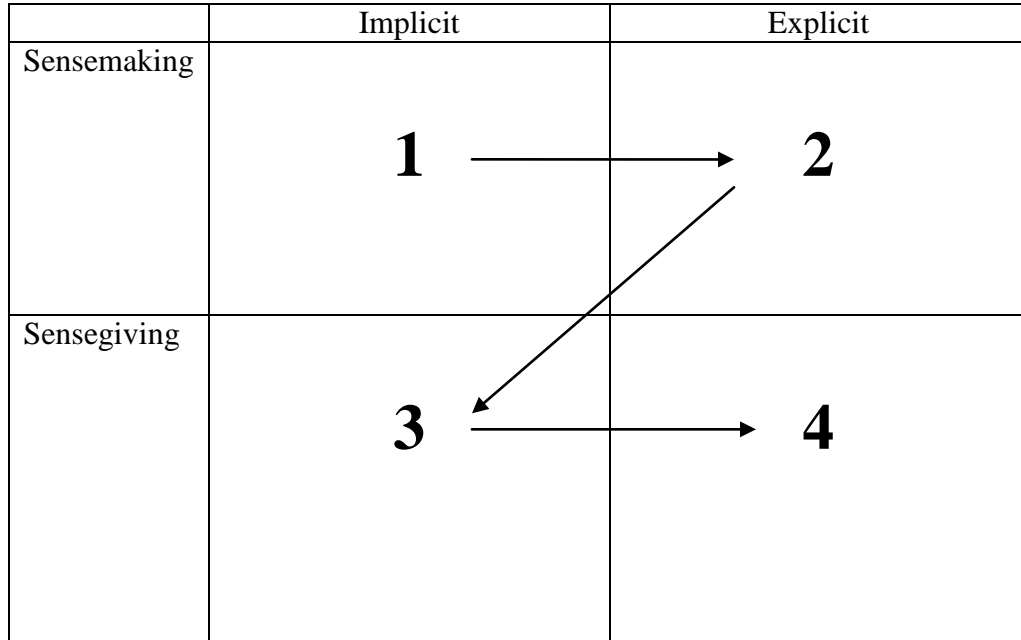
Patterns of Ineffective Updating



Failures of action: Suggestions not followed up on, hypotheses not tested

Figure 5.9

Bids for Attention: A Typology



Chapter 6

Conclusion

In this dissertation, I explored how updating was accomplished as part of complex interdependent work. I used a process approach (Weick, 1979) to studying updating and, more specifically, I engaged in an inductive qualitative study around two research questions: “What does updating look like?” and “When and how does updating occur?” in order to develop a rich understanding of updating. I used qualitative data from non-participant observations and archival video footage from both the ED and the medical simulation lab to develop a theory of updating that describes how actors accomplish updating in interaction with the environments in which they are embedded through more or less generative sequences of interlocked behaviors.

To briefly recap my findings: in my field study, I generated a rich description of updating as it was accomplished by ED healthcare providers. I found that updating did occur as part of everyday work – in contrast to the literatures that suggest that updating is almost impossible to accomplish – but I also found – in contrast to literature that presumes the presence of updating – that updating was a more problematic process than is often suggested. I found that ED healthcare providers were highly attuned to the challenges of updating and engaged in proactive behaviors to address those challenges. I began to develop theory around how updating was accomplished. My findings suggested that social interactions were central to the accomplishment of updating as part of complex interdependent work and I paid particular attention to a specific type of social interaction

– bids for attention (which I defined as, “an attempt of a team member to share something they have noticed (or realized) with other members of the team, with the intent to have the team revisit and possibly revise the trajectory of patient care”) – that drew issues of concern to the attention of the team and helped manage the flow of attention within the team. I found that bids for attention were not simply vehicles for transmitting information but rather served to shape the sensemaking and sensegiving within the team.

In my lab study, I extended and refined the theory that I had developed in my field study. I was able to evaluate the efficacy of updating in the more controlled setting of the medical simulation lab. I compared and contrasted the performance of 24 teams of ED healthcare providers as they participated in an asthma simulation scenario and found that most teams were able to update effectively around the central challenge in the simulation but that there was significant variation around the speed with which updating occurred. My lab study confirmed that social interactions were important for updating but also showed that updating emerged through interaction with the physical and cognitive environment. Because I was studying updating at the level of the trajectory of care, rather than at the level of any one type of actor (i.e. purely individual or purely team level), I was able to discern a number of different pathways through which updating was accomplished, ranging from an individual acting alone to collective action. I ended by elaborating my framework on bids and responses and argued for a return to basic units of organizing – sequences of interlocked behaviors in the form of double-interacts – to gain a richer understanding of how social interactions lead to more or less effective updating.

I turn now to a discussion of the contributions of my dissertation, the practical implications, the limitations of my study, and, finally, suggest avenues for future research.

Contributions

In both empirical chapters, I have highlighted my contributions to the sensemaking, adaptation, and coordination literatures. Rather than repeat myself, in this section I will draw some overarching conclusions related to the sensemaking, adaptation, and coordination literatures and will consider how my dissertation research speaks to two additional literatures: the literature on attention and the literature on error detection and correction.

Sensemaking: In distinguishing updating from naïve sensemaking, I draw attention to the idea of trajectories of cognition and action and my literature review and empirical investigation emphasized that, once underway, trajectories have their own momentum and are difficult to revise. My findings suggest that contextual constraints shape the way in which sensemaking unfolds, which is of interest not only to theorists but also – importantly – to actors (in this case, ED healthcare providers) who modify their workflow and engage in behaviors to manage some of the challenges associated with sensemaking in their particular context. My findings also suggest that updating involves revisiting a trajectory of care to determine whether revision is necessary but that updating is more complicated than its component parts and cannot easily be broken into the distinct sub-processes of revisiting and revising. Considering updating holistically allows for the consideration of the interplay between sensemaking and sensegiving and the exploration of the many different ways in which updating is accomplished.

Adaptation and coordination: In carefully studying the social interactions that form the basis for updating, I also contribute to knowledge around how transitions in understanding are coordinated. The research on coordination has primarily focused on the management of task interdependencies to the exclusion of other types of interdependencies (e.g., Crowston, 1997; Malone & Crowston, 1994). Much of the literature on adaptation and coordination presumes that homogeneous understanding is necessary for adaptation and coordination. For example, two dominant theories around how teams manage unexpected events are transactive memory, the “who knows what” division of cognitive labor within a team (Wegner, 1995), and shared mental models, the commonly held knowledge about task and team functioning (Cannon-Bowers & Salas, 2001), both focus on how individuals have access to shared knowledge.

However, there remain empirical questions about whether teams really do share a mental model (and whether a single shared mental model is ultimately desirable). Furthermore, an assumption of homogenous understanding neglects the notion that understanding within and of teams may evolve at different rates. My findings suggest that different team members’ understanding transitions at different times – for example, one team member may have updated their understanding (and want to revise the trajectory of care) but other team members may still be committed to the previous trajectory of care. This notion of heterogeneity around transitions of understanding is more in line with Turner’s (1978) notion of *variable disjunction* – the concept that knowledge evolves at different rates for different team members and, thus, that they have different understandings of the same situation – than the prevailing notion of shared common understanding (Cannon-Bowers & Salas, 2001; Cooke, Salas, Cannon-Bowers, & Stout,

2000). In addition to highlighting differences in understanding, my theory around updating suggests possible ways in which understandings transition and reach convergence.

Attention: Attention is a scarce resource within teams, especially in high-risk settings (Weick et al., 1999). Just as individuals cannot attend to all stimuli (due to limits in information processing), teams also have limits to the number of stimuli to which they can attend. The topics of attention and interpretation and information overload are long standing organizational questions. Past research has focused more on attention as an individual cognitive issue (Posner, 2004; Posner & Rothbart, 2007) or an organizational issue (Ocasio, 1997; Weick & Sutcliffe, 2006) and, if attention of smaller groups was examined, it was usually around what top management teams (as proxies of the organization) pay attention to (Starbuck & Milliken, 1988; Sutcliffe, 1994). It is only recently that scholars have begun to investigate the flow of attention within the team or group (Rerup, forthcoming) but this seems a promising avenue for future research.

Error detection and correction: One of the challenges of complex interdependent work in high-risk settings is that errors are inevitable and neither the prevention approach nor the reliability approach precludes errors (Blatt et al., 2006; Sutcliffe & Vogus, 2003; Wildavsky, 1988). In addition, acts often become mistaken over time (Paget, 1988). It seems that the best hope for mitigating or minimizing errors is to develop the ability of teams to detect and correct errors while errors are still small and early in their unfolding (Weick & Sutcliffe, 2007). Error detection and correction requires sensitivity to weak signals and the ability to revisit and revise a trajectory of care already underway. Understanding how updating is actually accomplished may provide insight

into the mechanisms that underpin error detection and correction and suggest interventions that can improve the ability of teams to minimize the propagation of error.

Practical Implications

The nature of my research question and the context for my research mean that my findings also contribute to the literature on medical errors. The initial research on medical errors was focused on defining (e.g., Hayward & Hofer, 2001), categorizing (e.g., Tamuz, Thomas, & Franchois, 2004), and enumerating medical errors (e.g., Kohn et al., 2000; Thomas, Lipsitz, Studdert, & Brennan, 2002). It is only in the last few years that scholars have examined organizing processes that shape errors (e.g., Carthey, de Leval, & Reason, 2001; Dixon-Woods, 2003; Faraj & Xiao, 2006; Hoff et al., 2004; Luria, Muething, Schoettker, & Kotagal, 2006; Rosenthal & Sutcliffe, 2002; Weick, 2002).

There has a fair amount of attention in the medical errors literature around developing regulation and policies to enhance patient safety (Kohn et al., 2000) and attention to improving organizational culture within healthcare organizations to be more conducive towards organizing for safety (much of this stream of thinking grew out of the experience of the aviation industry with crew resource management training, a program through which flight crews learned how to improve communication and decision making) (Katz-Navon, Naveh, & Stern, 2005; Malec, Torscher, & Dunn, 2007; Morey et al., 2002). My study suggests that an interactional focus would be a useful adjunct to the focus on culture and regulations.

One of the most important practical implications of this work is the finding that updating requires interactional competence. This study finds that even small interactions have significant effects – responses that build upon and extend the bids of others are

associated with faster and better updating. In teaching how to improve interactions, it would be beneficial to consider both developing skill in making bids and also skill around receiving bids. The mere absence of negative interaction is insufficient; rather, teams need to learn to engage in generative social interactions with each other.

The other more sweeping recommendation that I would make relates to the idea of keeping an organization in motion. One of the most striking findings from my lab study was that even if a team made significant mistakes – i.e. mis-intepreted physical cues, failed to consider a wide enough range of possible causes for the patient’s symptoms – much of the time, they were able to recover and eventually effectively update if the team kept the trajectory of care going and kept trying to figure out what was happening. There seems to be a fair amount of redundancy in the ways in which updating can be accomplished – if interacting with the physical environment wasn’t giving useful clues, then sometimes interacting with cognitive tools did. Fundamentally, social interactions formed the “last line of defense” so continuing to interact with each other was essential to being able to update. In the cases where social interactions ceased – i.e. bids were ignored or the team members got fixated on a specific task – action ground to a halt.

Limitations and Future Research

As mentioned previously, one of the main limitations of this study is that the data was collected at one organization. There may be boundary conditions to my theory that emerge both from my research site and from the type of data that I collected. The research site that I used is a dynamic high-risk setting where stakes for performance are high. It may be that actors in more conventional organizations would be less attuned to

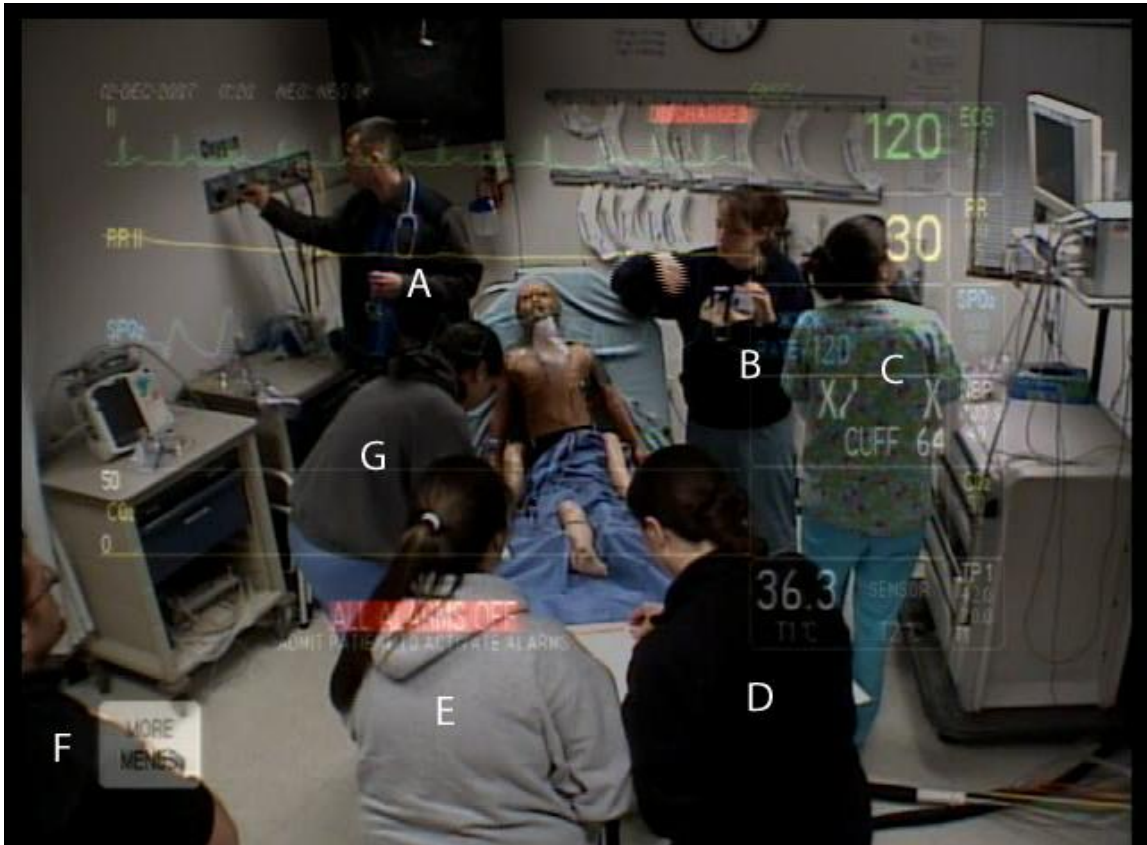
the importance of updating. As well, recall that I highlighted that this data was collected at a teaching and research hospital, where the norms for questioning a trajectory of care may be very different from those at a non-teaching hospital. Last, my data from the simulation lab come from a situation where the cue for updating is a physical one (broken piece of equipment). It may be that the patterns of updating that I noticed would have been different if the cue was different (i.e. more of a diagnostic puzzle).

There were also limitations around the type of data I was able to collect – I had initially hoped to be able to collect survey data to be able to account for some of the individual level variation that is hypothesized to be related to updating (for example, items related to Kruglanski & Webster, 1996's findings on motivation and updating). Due to the length of time that was required to get permission to gather my data, I was unable to gather a large enough sample to collect this data. Additionally, I was hoping to be able to compare and contrast team performance with supplementary quantitative analysis (log-linear analysis) but my sample of 24 teams was too small to perform a between -groups analysis on my variables of interest. I plan to pursue these lines of inquiry the future.

Additionally, there are two more specific avenues for research that my dissertation has prompted me to consider. First, I feel the potential of the simulation laboratory as a site of organizational research has not yet been fully realized and intend to pursue future projects in this setting. Second, I am especially intrigued by the idea of building upon the theory and methods that I have developed in my dissertation to map the flow of attention within teams and to learn more about how transitions in understanding (and action) happen within teams.

More broadly, my findings highlight that an observational approach (whether non-participant observations or micro-ethnography) is a rich method for collecting data around emergent processes. As many scholars have pointed out (e.g., Barley & Kunda, 2001), there is a lack of research on work as it is accomplished. I encourage other scholars to take seriously the situationally embedded nature of work and return to a study of how sequential interaction builds to create organizational processes.

Appendix A
Sample Timeline



- A: airway
- B: maybe resident
- C: nurse
- D: recording nurse
- E: nurse
- F: team leader
- G: nurse

General information:

Team of 7 people (5 women; 2 men). Team seems to be responding ok but not very good at generating other possibilities for why problems exist. Team leader (confederate) pushes team to figure out problem with bag (code = 1, confederate solves problem). This is a good illustration of a fairly unresponsive team with a strong leader.

Key times:

When patient stops being responsive (talking):

When someone on team first mentions that the patient is unresponsive: 5:05

When team begins to take action to deal with unresponsive patient: 5:17

When someone starts bagging patient: 5:59

When changing bag mentioned as solution to problem ventilating patient: 11:22; 13:10

When bag actually changed: 13:23 (confederate suggests this; code=1)

When and what alternate diagnoses considered (i.e. pneumothorax, choking, foreign body, faulty bag): 2:48 (list of possibilities); 11:14 (DOPE); 12:47 (not pneumo); 13:48 (fine vfib vs. asystole)

When summaries or "stepbacks" take place: 0:31, 2:48, 3:30, 13:48 (cause of arrest), 18:40 Team leader requests summary of patient vitals, 19:25 "just to recap," 20:30 "does anyone want to do anything else now?"

Updating moments: team has trouble updating. team leader; F seems to get frustrated; big separation between head of bed and foot of bed (i.e. completely separate conversations – for example, people at head of bed sorting out DOPE mnemonic; people at foot of bed ordering bicarb, which people at head of bed are unaware of until later).

- Update around decreasing respiratory function
- Update around non-functional bag – team does not arrive at idea to change bag on their own, despite big clues from confederate, confederate suggests bag change at 12:08).

Brief summary timeline

** note times displayed this way: *first discussed/ordered/given/+/- results back***

Purple text = Summary or stepbacks

Blue text = bids for attention

0:00 team figuring out who will do what role

0:25 C starts applying monitor leads

0:31 pt summary (F)

0:44 O₂ rebreather mask applied

1:12 F requests O₂ turned up to max

1:15 pulse check

1:26 ?IV started – patient is crying. F requests istat at same time

1:35 question about whether 2nd line wanted? F answers no.

1:40 B reads sats ?presumably to recording nurse

1:52 B asks F if he wants them to start bagging patient

2:48 patient summary by F including diagnostic possibilities

3:05 albuterol/atrovent/solumedrol/ and mg sulfate? ordered by F (check to see if said earlier)

3:30 F summarizes thinking about plan of action for team

4:10 B reads sats again

4:20 neb mask applied/nebs started

5:05 C (who has been shaking patient) taps patient "Hey, little patient... I think that he's not as responsive"

5:17 F asks C to do sternal rub; no response

5:23 F instructs team to assist ventilation (forecasts what is going to happen as sats decrease)

5:39 F orders sub-q epi

5:40 head of bed down

5:59 A starts bagging patient

6:28 solumedrol given

6:50 question from B about whether other airway aids required (oral airway, nasal trumpet)

7:28 sub-q epi (1:1000) (in at 7:55)

7:46 F orders 1:10,000 epi to be drawn up in case required (plus atropine)

7:58 "does ____ help?"

8:04 B reads sats again

8:11 F directs team to put board under patient and start compressions for bradycardia

8:22 B starts compressions

8:38 epi 1:10,000

8:40 question about whether intubation meds required

8:50 F summarizes dx and plan (asystole; chest compressions/epi/chest compressions)
F is getting tube out during this time

9:42 question: does he normally have pulses with compressions?

9:54 F asks, are we still sure we're getting good chest rise. Not 100% sure

10:12→10:35 intubation

10:38 F requests end-tidal.

10:45 (all this time sensemaking around whether breath sounds present)

10:53 bagging resumed

11:05 F instructs A to extubate and start bagging again

11:14 F stepback: "so, for some reason..." Goes through elements of DOPE

11:22 (equipment failure mentioned as possible cause; team feels equip OK)

11:32 F orders 2 14 gauge angio caths for decompression of chest (r/o pneumo)

11:39 F asks again, "sure equipment is working?" "yes" (A)

11:47 another dose of IV epi ordered

11:54 atropine in

12:07 side discussion at head of bed re: stabilizing airway

12:17 R chest needed

12:29 "do you want the epi?" – F refers to recording nurse

12:44 L chest needed

12:47 "so, it's not a pneumo" i think it's equipment. Start with O₂

13:10 F wonders if the bag is broken, requests change

13:23 bag changed

13:37 compressions stopped/13:45 compressions restarted (so can listen)

13:48 another summary (F) bag failure → arrest; fine vfib vs. asystole

14:09 F orders defibrillation at 2 per kilo (non-sync)

14:46 G delivers shock

14:51 B restarts compressions

14:58 F notes rhythm change (attributes it to shock); pulses regained
15:23 compressions stopped to check pulses
15:30 compressions resumed
16:23 atropine? (not sure if they give this)
16:28 compressions stopped to check pulses
16:40 bagging resumes?
16:55 F states they will try and intubate w/o meds but will give if pt gags
17:03 discussion about mag
17:10→17:23 intubation
(also a note about discussion re: meds)
17:40 *error detection* around mag sulfate (how to give)
18:00 F notes no end tidal reading
18:06 B reads vitals off monitor to recording nurse again
18:34 F requests someone else summarize what's happened ("someone besides me")
18:40 recording nurse summarizes changes since bag changed
19:12 F says he's going to check tube to make sure through cords
19:25 summary by F "just to recap" and during recap orders things:
19:44 F orders CXR
20:04 F orders inline albuterol through ET tube
20:28 F orders consult radiology; page unit
20:30 F asks for input "anybody else think of anything else?"
20:38 question about xray F explains CXR to r/o pneumonia or pneumothorax
21:14 B has question about 1st istat
F orders rpt istat
21:37 med nurse delivers set of syringes to push fluids
22:03 F reads CXR aloud to team
22:17 F summarizes "recap"

Expanded timeline:

0:00 team figuring out who will do what role
G to A: Do you want airway
Can't hear his response but he walks to the head of the bed and starts getting out airway supplies (rebreather mask)

D to E: Do you want to chart?
E: Yah, I want to chart
They switch positions so E is on the left and D on the right

SC (J): We have a little eight year old that uh they called the school. Had trouble breathing on the on the playground. Went to nurses' office. They didn't have any uh puffers there.

F: Any history of asthma.

SC: Yes he does

F: Did they have to do any intervention on the way in?

SC: Just put him on O₂

P: I can't...I can't breathe...
B comes in, touches patient's left arm
B: you've got airway, Jeff?
A: yep (looks at B and nods)
0:25 C starts applying monitor leads
B starts listening to patient's chest with stethoscope
P: Where's...where's... my... mom.
G: Hey buddy are you OK
P: I I can't breathe
G: Can't breathe
G: I can't tell - girl or a boy?

P: What're you doin?
[C: I'm hookin you up to the EKG... to trace your heart with
P: What're you doin?
0:44 A applies O₂ rebreather mask
While C is putting on leads by reaching under B's left arm (listening to patient chest), B points to three monitor positions. "This..."
C: So, white on the right. Red.]Physician on top (inaudible)

(overlapping conversation)

0:31 pt summary (F)

F: This is an eight year old brought from home. Sounds like he has a history of asthma. He has not gotten any albuterol today either at school or by the squad. They just put him on oxygen and he's been stable en route. So, can we get him on the monitors, and um get IV access, and get him on some "O"s... Let me know what you guys (inaudible)

G to F: 24 OK? (while opening IV cath package)

B to C: Put the physician one on top

B to F: Really not moving too much air

F: On the monitor at least so far all we've got are sats and they're 84%
1:12 F: Can we uh crank up his O₂ (looks at A, makes a turning gesture with his left hand) as high as it goes?
B adjusts mask on face
F: 1:15 How's his how are his pulses and stuff?
B, C, and A all check pulses.
1:26 patient crying
G: looks at F and says something I can't hear – maybe "line in"
A: I've got a radial
B: I've got a brachial
P: continues to cry, "what're you doin?"
A: (inaudible) on that side, I've got a radial over here

1:30 F: Can you draw an istat offa that?

G: Yes.

1:35 B: do you want a second line?

F: No not right now um

G: istat sent – hands pretend istat to SC

1:40 B reads sats ?presumably to D and E “sat of 87, respiration of 7, 126 heartrate, 89 sat, 6 respirations” (@1:52) to F? “do we want to start bagging?”

F: naah I mean his sats are 90%

G: OK (while looking at monitor)

F: he’s breathing on his own...

C: Is he movin enough air?

B (looking at C) Not much

F: Not much

Do we want to think about (inaudible – and can’t tell speaker)

?: Got good pulses?

Many people answer, “Yes”

F: So, do you think he’s wheezing when you listen to him

B: I can’t hear much wheezing but I don’t know if he’s just...

F: Can you press on his belly and see if his liver’s down

B examines patient’s abdomen

(F inaudible...”weird”)

A: I don’t hear any wheezing just not a lot of air moving (looking at F, moves hands up and down over lungs)

I don’t hear any wheezing

Abdomen’s soft

F: Are his heart sounds pretty regular?

A: I didn’t listen to that

B: Sounded regular

All sounds were present?

He’s goin down the list

laughs

B: 117 over 81 is the blood pressure, Nicole

2:48 patient summary by F including diagnostic possibilities

F: Alright, so you guys, a kid with asthma... um who has a history of asthma...that’s most likely what he’s got. Sounds like his heart and his liver exam are normal so it doesn’t sound like this is cardiac. With poor breath sounds this could be pneumonia, pneumothorax, um asthma. (3:05) But I would I agree I would give him albuterol, atrovent. Um we could give him a dose of solumedrol also. [Yes] Can we draw up some magnesium sulfate uh 50mg per kilo.

During above conversation SC comes onto screen and points out something on monitor cart. A picks it up – it looks and sounds like an wrapped IV bag. A takes it to the carts on the other side. He gets other things out of a bigger plastic bag. Maybe setting up nebs?

G: You're doin OK

P: I need to sit up...I can't breathe

G: You're sittin up

P: Can I can I sit up further?

G goes over to A;

3:30 F summarizes thinking about plan of action for team

So the things that I would do...those are pretty standard stuff...beta-agonists, steroids. Uh, if he's getting worse, then I'd give him subcutaneous epi...(B looking at F and nodding) that would be like the next line. I would try hard not to intubate him um because it's hard being asthmatic on a vent. We'll see if we can make him better instead of worse.

A and G having what appears to be a conversation about how to set up the nebs:

G: Then the med goes?....

4:10 B reads sats again: 124 heart rate. 87 sat.

C cycles BP on monitor

4:20 neb mask applied/nebs started

G: Gonna switch out the mask, OK? (to patient)...Put it on like 8 (to A)

E: Is that the standard albuterol?

G: (looking at E) Yeah

Fairly inaudible conversation about what dose of albuterol it was.

Confirming it was just one and not a double. People are focused on this conversation – joking, laughing, making jittery hands (albuterol makes you jittery).

4:39 A: You're on 8 L per minute. 8 L per minute.

Again, a difficult to hear conversation about confirming it was just one albuterol neb and not a double. People are focused on this conversation – joking, laughing, making jittery hands (albuterol makes you jittery).

4:58 C starts patting patient's chest

5:05 C (who has been shaking patient) taps patient "Hey" (pokes patient's chest) (people laugh) "I think that... not as responsive"

5:17 F asks C to do sternal rub; no response

F: Take your knuckle (takes right hand and makes a fist with middle knuckle sticking out and shows movement as he's talking) and shove it into his sternum really hard and see if he does anything

(E is also making an exaggerated knuckle rubbing movement with her right arm)

G: patting patient's shoulder) You OK? You alright?

5:23 F: Yeah, so he's (can't hear this. It's not "not responsive"). Let's go ahead and start assisting his ventilation...

A: OK (turns to get bag)

B is trying to get head of bed to go down

F: as his sats go down, his heartrate's going down.

5:38 F: We're gonna give him some sub-q epi (2) also
? (maybe med nurse or recording nurse D) Sub-q epi

5:40 head of bed down

5:59 A starts bagging patient

Off-screen med nurse: (very quietly) Alright, solumedrol if you want to give it (then inaudible – sounds like 20 mL). (clears throat; new speaking is much louder) I have your solumedrol (?per something)

Solumedrol if you want. I have your solumedrol.

F picks up syringe from off-screen person and hands it to G

Off-screen med nurse: It's 50 mg

G: Is it sub-q

Off-screen: 2.5

F: No, it'll go through the IV. Good question. Go ahead and just just push (makes a pushing gesture with hand) the solumedrol. It's not going to do anything for hours but at least it's on board.

Off-screen: Solumedrol for 50mg IV route.

6:23 B to E: Do you want an oral airway? Nasal trumpet? Anything like that?

6:28 G: Solumedrol is in.

6:28 F: Is is his chest moving when you bag him?

B: Yep (quietly) (nods head up and down)

(long pause – maybe 2-3 seconds – as A, B, C, and G look at patient's chest. C puts hand on chest then B puts hand on patient's chest)

A: I don't really notice that↓

C (or B): Kinda seems irregular

B to C: How did he sound?

C: He sounds more like (hard to hear – maybe really wheezy). I don't know what he normally sounds like but he sounds more like

F: When you're bagging him?

G: Radial pulses present....Femoral pulses present

F: He's bradycardic. So his sats are like 79%. Are we moving his chest when we bag?

A: It feels a little feels a little resistant.

F: So what are what are we worried about when we can't get chest rise when we're trying to assist him?

B: Reposition him

F: OK so yup reposition his head.

7:23 sub-q epi (1:1000) (in at 7:55)

F to G: Do you have the dose of epi?

G (looks at syringes in hand): I have magnesium sulfate

Off-screen OK I have the epinephrine, it's sub-q

F: We're gonna give the dose of sub-q epi... um but... and then... that's gonna be high like a 1:1000 dose

Off-screen: It's 1:1000 and it's sub-q so here's your (inaudible)

G: Thanks

7:46 F: [Because he's getting more bradycardic can you draw up a 1:10,000 dose that we're going to give IV if he doesn't get better and can you also draw up atropine]

Off-screen: Yes

[7:40 B to D or E: Nicole, I am still able to hear some wheezing now. He's still not moving much air

C: Is that what he sounded like before?

B: It sounds like I] ... I hear more wheezing up here

G: Sub-q epi's in

7:58 F to people at head of bed: Does repositioning help?

A: Yeah, little bit little bit

8:04 B: Nicole, sat is 78.

A: Just had a run of ...uh ...sort of asystole (doesn't address this comment to anyone. Says outloud quietly while looking at the monitor)

B: do we still have pulses?

F (feeling patient's right dp pulse) Naah...

B: No. (takes off stethoscope to listen to patient)

F: Go ahead and get a board under him and do chest compressions.

G: Wait! Now I have pulses

F: yeah but he's still bradycardic

G: OK. Start C... compressions?

F: He needs to get compressions. So we need a board under him

8:22 B starts compressions

C to B: Just tell me when you're ready

G: Ready

B stops compressions; G rolls patient toward her; C puts the board under patient

8:38 Off-screen: I have here epinephrine IV 1:10,000 when you need it.

F: We're gonna go ahead and give that (pointing at G)

A: (looking at monitor) (something inaudible, G looks at him as he talks)... basically
8:40 B: Do you want to pull the intubation meds up
F: Well if he's in arrest he doesn't need meds we'll just tube him
B: OK
A: OK

Off-screen gives syringes to G: Here's your epinephrine IV 1:10,000
G: Epinephrine 1:10,000

8:46 F: I'll get... you keep bagging... I'll get that stuff set up. So you guys chest compressions. Epinephrine. Chest compressions. This is asystole or severe bradycardia. Um we don't need to do pulse checks until we're better on the monitor. Um the only thing we would look for is if there's any sign of vfib or vtach on the monitor then he would need electricity.

G: Epi's in
E: Thank you

?: (maybe D to E or vice versa – there's something inaudible before this – I think it's someone asking the dose of the epi): 1:10,000

F: How old is he guys?
?: Eight
F: OK (he's getting tubes from the wall)

B to F (she's turned to look at F getting tubes off the wall): I think we had to go with the 5 last time...

F (maybe, can't see): OK
A: Age. 8 + 16 is 24.
B: the 5 and a half one was too big
A: Six ... what's that?
B: the five was too big for him last time.
A: what was it?
B: the five and a half was too big.
A to F: did you grab the five?
F: five
A: OK

9:42 C to F: Does he normally have pulses with compressions?
F: He should, yes
C or G: No pulses with compressions
F: OK, continue with compressions

9:54 F: So are we are we still sure that we're getting good chest rise 'n stuff?
A: not we're not 100% sure

B: Could someone listen to him?

G listens to patient's chest)

F: Do you want to intubate him?

A: I can try

F: I'll go ahead and bag him

G: I'm not hearing anything

B: Hold for a moment

10:13 B stops chest compressions

10:12→10:35 intubation (A intubates patient)

A: (first word hard to hear: visualize vs there's) the cords

Lots of silence

B: does someone want to listen?

10:35 B resumes compressions

G takes off stethoscope and is listening to patient's chest

10:53 bagging resumed (F has applied the bag to the tube and is bagging)

10:38 F: Can we get the end-tidal?

C gets end-tidal off monitor cart and hooks it up

F: Are you hearing breath sounds?

G: See, I can't tell if I'm hearing that (points at bag)

E: What size tube is that, (?Jen)?

B to E: Five

F: Uh hold onto your tube so it doesn't move

F: OK, I'm not getting anything on the end-tidal

G: I think I'm just hearing that

11:05 F: OK, so we don't have breath sounds. Go ahead and let's... go ahead and pull out and bag. You may be in but it's just not workin'

11:14 F: So, for some reasons we're just not moving his chest. He's not obstructed right?

You didn't see anything in there, in the way.

A: I didn't see. No visual.

F: Um so... Dislodgement. His tube is out so it shouldn't be a problem. He's not obstructed. Does he have a pneumothorax? And is this an equipment problem? That's kind of the DOPE mnemonic. So, can we get (@11:32) two 14 gauge angio caths and shove it in his chest (points index fingers into both sides of his own chest). Um and are we sure that our equipment is working?

(2 second pause: G and A are looking down to patient's chest)

A: Yeah

G: Do you want me to get the atropine?

F: Yes.

11:47 F: And can we get another dose of epinephrine three minutes after the first one?

Off-screen: Would you like IV, again?

F: Yes, 1:10,000. Everything from here on out will be IV 1:10,000

11:54 G: Atropine .5 is in.

11:59 There's the chest.
The chest. The chest has arrived

12:07 side discussion at head of bed re: stabilizing airway
B to A: Would you like a towel roll for his head?
A: What's that? What's that?
B: Put him in a C-collar to stabilize or put like a towel-roll under his head.....to stabilize the airway?
A: doesn't answer with words but waggles his head back and forth no

Off-screen nurse comes on screen and goes over the G and hands her syringes: Additional dose of epinephrine 1:10,000. 2.5.

12:17 R chest needled by F
F: Um, the right chest has been needled with no (checks with SC) no whoosh
SC: no whoosh
B: What was he doing at the time? Like?
12:29 G: "do you want the epi in?"
F: Yes...

F: well, these guys should know when it's time (points to recording nurses)
G: When did I give the epi last?
D or E: Now. You can give it now.
G: Thanks. Epi is in.
Off-screen. That was 0.25 mg.

12:44 L chest needled
F: The left chest is in. No whoosh.
12:47 F: Alright, so it's not a pneumothorax. I think guys it's our equipment. So can we start from where the oxygen comes out and find out if we have a problem.
SC: I've got the chest tubes ready
G: Oxygen's all the way up
F to A: Do you feel like you are actually getting?
A: Do you want to see what you think.. feels a bit resistant
F comes over and gives the bag a couple of hard squeezes
13:10 F wonders if the bag is broken, requests change
I'm wondering if the bag's just not workin. Let's switch our bags.
A: OK
F: You can start bagging before you ken get it hooked up.
13:23 bag changed (By A)
A: Yeah, definitely, much better

B: What was the history? What was he doing?
F: He was in school
B: Playin on the playground

F: Do you have chest rise now? Stop compressions just for a second
13:37 compressions stopped/13:45 compressions restarted (so can listen)
F: Are you getting breath sounds?
G: Yes, slight
A: It's easier
F: Continue compressions

13:48 another summary F: Alright so I think our bag was faulty so I think he has not been getting good oxygenation for awhile. Um so it's probably why he arrested...because his sats went down so low. Um the question is do we think this is fine v-fib or asystole?
? (can't see speaker on screen): I would go with v-fib..
A: That's what I would say.

14:09 F: Let's jolt him up (makes a double thumbs up sign with hand and raises them up once)

G (presumably to F): What's the number? (turns around and starts to uncover the defibrillator)

F: 2 per kilo of non-synchronized so don't hit the sync button

Off-screen: Defibrillation would be five – zero

F: OK, so fifty

G: (getting out leads) We want him on this monitor?

?: Yep

F: No, just (points to the main monitor).

?: (something inaudible)... just defibrillating

F: I don't care yeah we're not gonna synchronize him.

G: So what do we want him at?

Off-screen: Five - zero

F: So fifty as in greater than forty less than sixty?

Off-screen: Correct

F: Not fifteen?

Off-screen: Five-zero...

F: OK, OK, alright

Off-screen: Less than sixty.

F: I'm just clarifying (makes a defensive hand's up gesture)

G: Ready ...Clear.... Clear.

14:46 G delivers shock

F: 'Kay, just do compressions. Just keep doin 'em

14:51 B restarts compressions

Off-screen: The second (inaudible – maybe attempt) would be seven-five

14:58 F: So, so I would agree with you (points at D who is nodding head) that that was v-fib because now he looks like he has a rhythm

G: He does have pulses

F: 'Kay keep goin we're gonna go for a couple of minutes

I feel like (inaudible)

Are you tired

C: Do you want me to take over

B: Oh, it doesn't matter

Inaudible

G: I'll be in charge of juice

F: Do you guys feel pulses?

G: Yes (feeling right radial pulse)

C: Yes (feeling left femoral pulse)

15:23 F: Stop compressions for a second. (pause) You do feel pulses?

G: Yes

F: OK because his heart rate is only 40's I would continue compressions. [15:30 B resumes compressions]

Is he still bradycardic? Can we get a dose of atropine?

Off-screen: Yes.

B or G: 'Cause he's still hypoxic? That he's bradycardic?

F: Um hm yeah I think that's the reason. As his sats come up this should come up but I would continue compressions until he's a little better perfusion.

B: Is his belly distended? Does he need an NG or anything?

F feels patient's abdomen

F: We just weren't we weren't we weren't bagging anything in

?: So it went to his belly?

Right

F to A: So, let's let's get you to intubate him. He obviously needs to be intubated (inaudible something about a stylet)

16:23 Off-screen comes onscreen and hands syringes to G: Atropine 0.5

G: Thank you

F goes to put stylet in tube and drops tube

F: We're gonna assume it's sterile. We're gonna take the stylet off the floor. We're gonna assume it's sterile

As he goes to put the stylet in the tube again, F drops the tube again

G: You did it again.

?: Just lick it

G: Do you want atropine?

F: Uhhh. Actually hold it right now. (laughter) Good question. Awright. Let's stop compressions. [16:28 compressions stopped to check pulses]

We're in the 70s... do we have better pulses?

C: Yeah, they're more regular...

F: OK

C:... than they were

F to A: Let's go ahead and switch. I will bag him while you get ready.

16:40 F resumes bagging

Period of silence

16:55 F to foot of bed: We're gonna try to intubate him without meds.

?: OK

F: If he starts gaggin' 'n stuff then we'll give him other stuff.

?: Um start with the lidocaine (inaudible) mg

17:40 *error detection* around mag sulfate (whether given)

F: So has he gotten his magnesium yet?

D or E: Um, I don't believe he has

(overlaps)

A: I'm ready

F: Ready?

A: Yeah

F: I got cricoid pressure

A: Visualized the cords. Through.

17:10→17:23 intubation

G: I had it. I don't think...

Maybe he has

G: I had it. Did I give it back to someone?

D or E: We have albuterol, solumedrol, epi 1:1000, epi 1:10, atropine, another epi 1:10.

Off-screen: Do you want an additional mag sulfate?

G: Did I get one already?

Off-screen: You did

G: I did push it?

F to A? What did he sound like?

B listening to patient's chest

Did you push it?

Off-screen: It's been handed forward

What was?

G: Yeah, I think I gave it.

Off-screen: Atropine?

G: Here it is

Mag sulfate?

D or E: Mag sulfate. No. We don't have it written down

G: No mag sulfate given

F: OK. I would go ahead and uh you have to give it over twenty minutes. It's not something you can push so you need to put it on a pump

G: It's on a pump (pretending to have a pump. Laughter)

F: Do we have...

B: I'm startin to hear it now

Off-screen comes on-screen and gives something to G: Here's your tubing

18:00 F: We don't have an end tidal, though.

18:06 B to D or E: Nicole, vitals: 85 heartrate. It was 18 at first. 89 sat. 123/41.

F hands bag to A: You bag. I'm gonna look to make sure...

A: (difficult to hear) The tube?

F: I think it is. His sats are better. They're hearing chest rise. I just don't know why we don't have an end-tidal.

A: Sats are definitely coming up

18:34 F requests someone else summarize what's happened

F: Right so somebody beside me since you've been kind of globally looking at him. How we've been doing overall on the last couple of minutes with our vitals?

18:40 D: Ummmmmm our pressures are lookin OK. Our sats have been comin up. Our pulse has been getting better. Pulse was in 70's and now we're in the low 90's. We look we look like we're improving

B: I don't feel a brachial pulse right now but we do

SC: Are those chest tubes in?

G: I feel brachial.

B: I don't know...

D or E: That's still a five-oh tube?

SC: You gonna put those chest tubes in?

F: Yeah, I'm not gonna put them in; he didn't have a whoosh of air

D or E: What's the marker at the lip for the tube?

F: Fifteen. Yeah, it's definitely between the cords. Alright. So, we're startin to get a bit of an end-tidal.

19:23 OK so you guys. Just to recap. Clinically he's now intubated. I think the reason he arrested is because he was so hypoxic because we weren't delivering any oxygen because we had faulty equipment. Um he's intubated with a tube that sounds equal – correct? [Mmmhhh]And we can see it going through the cords and we have an endtidal. So we need to get a CXR (19:44) to confirm that also to look at his lungs to make sure that he

doesn't have any pneumothoraces that um we're not gonna make worse now that we have positive pressures. Um from a circulatory standpoint, he's still a little bit bradycardic for somebody who should be in significant distress. We need to inline some albuterol through here (20:04). And I would give him some fluid. Probably give him 10 per kilo and push it. So like 250mL and push it. And who votes he should go to the ICU?

Everyone says "Me" and raise their hands

G: Especially because he's intubated

B: Take him to the floor (waves right hand in)

F: Yep so the floor's not gonna be too happy

Maybe C?: Take him back to Area C

20:28 F: Can we call radiology and page the unit? 20:30 Does anybody want to do anything else right now?

G: So we're gonna get the xray now.

F: We're gonna the xray

G: Confirm placement

F: Confirm placements. Make sure we don't have like a big pneumonia that needs to be treated

G: Or pneumo

F: Or a pneumothorax needing a chest tube.

21:14 B: Does the istat look OK?

F: I haven't seen it. But we should probably.... That's a great idea. That was before he arrested. We should probably get an istat now. So if we can draw up more blood for that. Um OK, I'm gonna wander to the foot of the bed. (moves to foot of bed)

Talking and quiet singing in the background.

SC: Xray's been called and is coming

G: Istat?

SC puts paper (istat) on table

D: First istat. Second istat was drawn.

F: [This was before he arrested. So before he got before we made him worse his pH was 7, base deficit -15, but his 'crit, his glucose, his sodium and his potassium were fine. So it was a mixed metabolic and respiratory.] So that's his film (points)

[*overlapping conversation*]

B: So we decided that's not...that's not how he always sounded?

G: I couldn't hear anything... (inaudible)

A: (shakes head) Yeah, but it wasn't much

21:37 Off-screen nurse (hands five big 50cc syringes full of fluid to G): We need this fluid IV push. We need 250. That'll be a bolus for his weight.

G: She's good! (looks down at the handful of syringes laughter) Thanks

Maybe D or E: That's awesome.

F: That's absolutely excellent.

G: I'll start pushing fluids

?: If you (something inaudible) those syringes back at me.

22:03 F: You guys, it looks like he's hyperinflated. I don't see a pneumothorax, although it's a supine film. With sats of 95 I wouldn't do anything else. His ET tube looks in the right place. Let's give him some fluid.

22:17 To recap. He's gotten his solumedrol? He's getting his mag? Is that right

Off-screen: Yes

G: Yes

F: So. Alright. The only other thing I would do for him is titrate a drip. They can do that on the unit.

Chatter

F: Alright guys we're good (claps hands)

Appendix B

Coding Instructions

Steps for coding video:

1. Make a **timeline of key events**, focusing on changes in trajectory or updating moments. Please identify and describe:
 - a. When patient stops being responsive (talking)
 - b. When someone on team first mentions that the patient is unresponsive
 - c. When team begins to take action to deal with unresponsive patient (describe what's happening)
 - d. When someone starts bagging patient
 - e. When changing bag mentioned as solution to problem ventilating patient
 - f. When bag actually changed
 - g. When and what alternate diagnoses considered (i.e. pneumothorax, choking, foreign body, faulty bag, etc)
 - h. When summaries of patient status occur (i.e. "Let's take a step back...")
 - i.
2. Once you have constructed an initial timeline, **identify key updating moments** (where trajectory of care revisited and possibly revised). Work backwards on the video from these moments to see when intention or need to revisit trajectory first expressed and **create an even more detailed timeline** of conversations and actions leading up to and including the revisiting and (possible) revising.
3. Specifically, flag moments that are ***bids for attention***, which are an attempt of a team member to share something they have noticed (or realized) with other members of the team, with the intent to have the team revisit (and possibly revise) the trajectory of patient care.
 - a. Please describe bids for attention and indicate whether they are:
 - i. *explicit*: i.e. "The patient doesn't seem to be responding to our treatment – can we take a step back and look at what's going on?" or "This isn't working"
 - ii. *implicit*: i.e. "This lab result seems weird" or "I'm wondering if..."
 - b. In addition, if you can, please describe *to whom the bid is made* (i.e. specific individual(s) or whole team)
4. As we've talked about before, there are various ***responses to bids***:
 - a. Responses to bids should be identified as either:
 - i. *positive*: acknowledges bid and builds upon it. This type of response can take many forms including being encouraging or

- ii. supportive, asking follow-up questions, taking action in response to bid (i.e. “the patient is not breathing” – an appropriate action in response to that is to put down the head of the bed and start assembling supplies to manage the patient’s airway). Asking others what they think about bid. It can also involve thanking or humorous interactions (i.e. joking in a positive not mean way).
 - iii. *neutral*: ignores bid or acknowledges bid (i.e. gazes at speaker or nods) but, in contrast to positive responses, there is no building upon the bid.
 - iv. *negative*: belittling comments, sarcasm, anger, mean, or aggressive comments or actions are all negative responses to a bid for attention.
 - b. As well, there can be variation in *who responds to the bid*. It’s helpful if, in your rich description, you can indicate whether the response to a bid is by an:
 - i. individual (especially important to note if the individual is the team leader)
 - ii. some portion of the team
 - iii. whole team
- 5. It’s also helpful if you can include in your description your overall impression of the team (just as we’ve done in our conversations i.e. “the team is good at having transitions in understanding but not in transitions in action” or “joking around a lot” or “not responding to each other”)

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