

CONTEXT: MUCH ADO ABOUT – WHAT, EXACTLY?

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Lay Abstract

(146 Words)

Educators in the health professions have the important task of preparing their students – future physicians, nurses, paramedics, etc. – to perform effectively in clinical practice. This transition from healthcare *student* to healthcare *professional* is challenging, in part because classrooms and clinical contexts are different entities: the environment, the people within it, the way knowledge is generated, recalled and applied are all different. To narrow the gap between classroom and clinical practice, educators often promote *learning in context*, using various strategies to make the classroom more like the clinic (or any other setting in which health care is delivered). The challenge, however, is that exactly what features of the practice setting (context) should be recreated to promote learning is not known. We undertook this study, viewing the clinical context through a paramedic lens, to better understand what features present in real world conditions might influence learning and performance.

Abstract

(272 Words)

Introduction

Simulation-based learning is an example of *learning in context* in which clinical contexts are recreated in controlled settings to facilitate deliberate practice. While widely regarded as effective, unanswered questions exist about what elements of the clinical context must be recreated in simulated settings to promote authenticity. Moreover, the degree of authenticity (or fidelity) required for optimal learning is not known, with current thinking often deemphasizing the importance of physical realism. We therefore sought to explore contextual influences on performance in a ‘context-rich’ clinical setting: paramedicine.

Methods

We followed constructivist grounded theory principles and recruited currently practicing paramedics to participate in one-on-one, semi-structured interviews. We asked the participants to describe a recent experience in which they attempted to resuscitate a victim of sudden cardiac arrest and asked them how to recreate their experiences in simulated settings.

Results

Fourteen paramedics provided a total of seventeen interviews, each describing a distinct cardiac arrest event, yielding over ten hours of audio data for analysis. We iteratively identified three major interrelated themes describing contextual influences: *the event* – its physical characteristics, circumstances and people present; *the conceptual response* – the cognitive processes and challenges encountered; and *the emotional response* – the degree of emotional engagement in the management of the resuscitation. We also identified a major theme related to how to simulate these events. Collectively, our results suggest a complex and dynamic interplay between the physical, conceptual and emotional domains of context.

Conclusion

In contrast to other conceptualizations of context and fidelity, our results suggest that conceptual and emotional responses occur as a result of physical features in the practice environment, arguing in favour of physical authenticity in simulation.

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Finally, I wish to dedicate this work to the memory of my Grandmother – *Nancy Ethel Mausz* – who died during the study after living a long and beautiful life. I grieved your loss and carried on with the work in the spirit of the values you instilled in me – to attend to the details, to be kind to others, and to be true to myself.

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List of Abbreviations

ACP = Advanced Care Paramedic
ALS = Advanced Life Support
CPR = Cardiopulmonary Resuscitation
DNR = Do Not Resuscitate
EMS = Emergency Medical Services
IV = Intravenous
King LT = King Laryngeal Tube
MG = Milligrams
PCP = Primary Care Paramedic
PBL = Problem-Based Learning
RRU = Rapid Response Unit
SD = Standard Deviation
TOR = Termination of Resuscitation
VSA = Vital Signs Absent

Declaration of Academic Achievement

The following is a declaration that the research described in this thesis was completed by Justin Mausz under the supervision of Dr. Meghan Mconnell and with the assistance of Drs. Walter Tavares and Sandra Monteiro. JM was responsible for the conception, design, implementation, collection, and analysis of data during the study and the writing of the thesis. MM, WT and SM provided conceptual guidance and mentorship during all phases of the research and manuscript preparation.

Epigraph

“I guess that’s the question, what do you mean by ‘real’ – I don’t mean that in a philosophical sense – I just mean, how real is ‘real’ in terms of what you want it to be?
And does ‘real’ matter?”

Study Participant ‘Samantha’

Chapter 1: Introduction

Section 1: Context in Learning

The goal of healthcare education is to prepare clinicians to perform effectively during clinical practice. Making the transition from classroom to bedside is presumably smoother if some of the learning time has been spent in clinical settings, yet the degree to which we should attend to the learning context in instructional design is unclear. The debate regarding the utility of *learning in context* in healthcare education hinges on an understanding of how context might influence learning. For example, Durning & Artino in defining their *situativity* framework argue that learning is a “fundamentally social and cultural” phenomenon (Durning & Artino, 2011).

“Knowledge is not an inert, self-sufficient, abstract, self-contained, symbolic “substance” independent of the *situations* in which it is learned and used. Instead, proponents of situativity theory view knowledge more like a tool ... the tool, the participant(s) using the tool, the environment, the specific context and the culture are all *interdependent* – you cannot meaningfully understand one of these components without understanding the others; they are situated.” (p. 189)

Situativity theory places the learner and the learning context on equal footing and emphasizes the use of meaningful tasks in authentic learning environments to facilitate learning. However, the role (and importance) of context in learning varies widely across different epistemological orientations toward teaching. These differences in perspectives are important because the concept of learning in context underpins a variety of instructional strategies used in health professions education today.

Section 2: Epistemological & Theoretical Perspectives on Context

Behaviourism

In behaviorism, knowledge is viewed as a repertoire of learned behaviors (Ker & Bradley, 2010). In classic behaviorism studies, learning occurred when a simplistic stimulus was paired with a response or more complex behavior. Applying a behaviorist approach to education, learning occurs when behaviors are either reinforced – through the provision of *rewards* (positive feedback, passing grades) – or discouraged – by *withholding a reward* or administering a *punishment* (admonishing a student or assigning a failing grade) – in a process referred to as operant conditioning (Illing, 2010; Mann, 2005, 2011). This process of reinforcing or extinguishing behaviors depends on the provision of feedback, which in behaviorist approaches to learning, is seen as originating from the environment. Finally, in behaviorist orientations, cognition is not emphasized, instead,

the focus is on observable behaviors, such as performance on a test or the achievement of certain competencies.

Stated differently, in a behaviorist epistemology, learning is the net result of either reinforcing or extinguishing behaviors. Within behaviorist approaches, the role of context is to *facilitate the delivery* of this feedback, an approach that is most useful in supporting the development of technical skills.

The skills acquisition literature emphasizes the importance of feedback in developing expertise. Feedback serves to provide information to the learner on the success or failure of an attempt and to prescribe corrective guidance for subsequent attempts and can broadly be classified as internal or external depending on its source (Lefroy, Watling, Teunissen, & Brand, 2015). Internal feedback is information on process and outcome provided to the learner as a result of their interface with the specific learning task and is delivered via the senses in the form of visual, auditory or tactile cues during performance (Sigrist, Rauter, Riener, & Wolf, 2013). An example of this type of feedback would be the tension in a suture a physician feels when tying a knot. By comparison, external feedback is provided by others (usually – but not always – experts) outside the learner-task interface (Rohrer & Pashler, 2010; Wulf, Shea, & Lewthwaite, 2010). The intention is to provide information that prescribes corrective guidance both on process (i.e., how the skill is performed) and on outcome (i.e., success or failure). While there is still uncertainty regarding the optimal timing and amount of feedback (Hatala, Cook, Zendejas, Hamstra, & Brydges, 2014; Walsh, Ling, Wang, & Carnahan, 2009), the concept that feedback enhances learning – and is critical to success – has been well established (Lefroy et al., 2015; Ramani & Krackov, 2012).

Cognitivism

In contrast to behaviorism, in which the focus is on the environment, largely ignoring the role of the mind, cognitivist approaches to learning emphasize the importance of cognition and have played a significant role in advancing our understanding of processes related to learning, memory formation and information retrieval (Hodges & Kuper, 2012; Mann, 2005, 2011). Within cognitivist orientations to learning, context is believed to be an important determinant of memory formation.

Cognitivists are devoted to the study of mental processes, such as memory, attention, problem solving and learning and have described a number of theories about how the brain processes new information and integrates it into memory, most notably the *information processing theory*. First described in 1972, information processing theory suggests that human memory is analogous to how a computer functions. Memory can be organized into three levels of storage: sensory, short-term (more commonly referred to as *working*) memory and long-term memory (Craik & Lockhart, 1972). Sensory memory refers to everything processed by a person's senses – sight, sound, temperature, taste, etc. – and has a very limited capacity, typically only a few seconds (Craik & Lockhart, 1972).

When information is *attended to* in some way, it enters short-term or working memory. This level of memory has a capacity to handle approximately 7 to 9 items simultaneously with a duration of a few minutes (Cowan, 2008, 2014). Finally, long-term memory has no known limits with respect to its storage capacity or duration; within information processing theory, learning is viewed as the integration of novel information into long-term (Cowan, 2008, 2014).

Put differently, if you are in a library, your eyes will ‘see’ all the books around you; however, your memory of the books that you ‘see’ will fade rapidly, if it registers at all, unless you attend to a specific book in your environment – by picking it up, for example. If you read a few pages of the book, concentrating on the words in the pages and their message, you may remember some of what you read for a few minutes as you process the information in your working memory. If you relate something you’ve read in the book to something you already know, you’re engaging in a process called *schema elaboration* (Cowan, 2014), in which new information is added to information already stored in your long-term memory; information processing theorists argue this integration of information is learning.

Memory is an associative process by nature. When information is processed in working memory and encoded into long-term memory, inevitably elements of the context in which the learning occurred are encoded as well (Smith, 1979). When remembering a passage of the book you read in the library, for example, you are likely to remember some details about the library or the time you spent there. This phenomenon, referred to as *context-dependency*, has been the subject of study for some time.

Perhaps the most well known experiment into the effects of context dependency is an investigation by Godden and Baddeley in 1975. In their experiment, the investigators tasked scuba divers with memorizing lists of commonly used words in two “natural” environments – on land and under water. The investigators then tested the divers’ recall of the words in environmentally similar or dissimilar settings and found that recall was improved when the testing condition (asking the divers to recall the words they had been shown) matched the learning condition (when the divers were first shown the words) (Godden & Baddeley, 1975).

A number of other experiments revealed the superiority of matched-context recall in laboratory settings (Eich, 1985; Parker, Gellatly, & Waterman, 1999; Smith, Glenberg, & Bjork, 1978a, 1978b) while others suggested that mentally reinstating the learning context during recall (i.e., by imaging the learning environment) could achieve similar results (Smith, 1979). Similarly, recall is improved when study participants are asked to remember specific features of the environment in addition to the words presented to them (Eich, 1985). Interestingly, when tested in more realistic, and hence less controlled conditions, the context-dependency effect is less pronounced. In a 1985 experiment in which college students were randomly assigned to their original classroom or a different classroom when tested on recently learned material, the investigators failed to identify a

benefit for matched-context performance (Saufley, Otaka, & Bavaresco, 1985). Put differently, students who were tested in their own classroom didn't perform any better than students who were tested in different classrooms. Saufley et al. note that experiments in carefully (and cleverly) controlled laboratory settings may not be transferable to less controlled conditions found in everyday life. Nevertheless, these experiments provided an important empirical foundation from which to draw conclusions about learning; namely that memory is, to some degree at least, context-dependent.

Social Learning & Social Constructivism

Finally, social learning theories (arising from a constructivist epistemology), are concerned with how learners derive meaning from and make sense of their experiences (Illing, 2010; Kaufman & Mann, 2010; Mann, 2005, 2011) and the role of context is emphasized as a medium to promote transformative learning.

Social constructivism is predicated on the notion that learning is a process that occurs jointly between the learner, the teachers and others in the learning environment, arguing that learners mutually develop a shared understanding of the world around them (Kaufman & Mann, 2010). These interactions can be micro-level, such as those occurring between small groups of learners in a tutorial room or macro-level, in which entire workplaces, communities or professions are viewed as groups of people working collaboratively to achieve common goals (Hodges & Kuper, 2012). Learning is seen as constructing meaning from experience. The social constructivist orientation informs a number of learning theories that emphasize participation among learners, including situated learning and situativity theory.

In *situated learning* (or cognition), learning is seen as a transformative process occurring as a result of the interactions between learners in a particular context. Situated learning views the learner as an active participant in the learning process, learning from others through language, observation, participation and role modeling, in a process intended to develop the learner's knowledge, understanding, and professional identity (Hodges & Kuper, 2012; Kaufman & Mann, 2010; Mann, 2005, 2011). In situated learning, "the community becomes the learning resource" (Mann, 2011), helping to socialize the learner to the accepted norms, values and customs of the profession as the learner transitions from a peripheral to central role. Participatory learning is viewed as particularly important in situated learning. Mann (2011) characterizes it succinctly by saying:

"Participation *is* learning, and as participation is ongoing, learning is viewed as a continuous process. ... Participation sees learning as inextricably tied to its context and embedded in the social processes there." (p. 64)

This interactivity is, in large part, the primary mechanism by which learning is believed to occur. In situated learning, legitimate peripheral participation is emphasized with

incremental increases in responsibility, as the learner gradually becomes an accepted and contributing member of the community (Mann, 2005, 2011). Through participation and contribution, the learner is seen as learning *from* the community and, in turn, the community is seen as learning from the learner (Mann, 2005, 2011).

In *situativity theory*, knowledge, thinking and learning are seen as grounded in experience. During et al. offer this definition:

“Situativity theory stresses the social nature of cognition, meaning and learning with emphasis on the importance of the participants and the environment, as well as the evolving interaction between the participants and the environment within which thinking and learning occur” (p. 188)

Situativity theory views learning as a “fundamentally social and cultural” process wherein learners engage with others and the learning environment itself (Durning & Artino, 2011). In comparison with behaviorist schools of thinking which view knowledge as behaviors occurring as a result of stimuli or cognitivist orientations which view knowledge as novel information to be integrated into long-term memory, situativity theory views knowledge as intimately tied to situations and embedded within the functional context of its use (Durning & Artino, 2011). Knowledge, situativity theorists argue, is a tool: something whose function and meaning is defined by the individual using it; a definition inherently tied to context. For example, two people might view the utility of a hammer differently depending on their previous knowledge and understanding (construction worker vs. archeologist) and the context of its use (construction vs. unearthing ancient artifacts); in either case, devoid of personal or contextual meaning, the hammer itself has no meaning (Durning & Artino, 2011). In this light, it would be more appropriate to say that situativity theorists see the potential of knowledge and its applicability across a broad range of individuals and functional contexts.

Section 3: Synthesis

In summary, these three orientations to learning each position the role of context slightly differently (see **Figure 1**). Behaviorist approaches suggest knowledge is a repertoire of learned behaviors (or competencies) and argue that the role of context is to facilitate feedback to encourage or discourage these behaviors. Cognitive approaches emphasize the role of cognition and memory formation, viewing knowledge as novel information to be integrated into long-term memory, retrieved and applied to solve problems. Within cognitivist orientations, context is a variable that can either enhance or threaten transfer. Finally, social learning approaches view learning as an inherently social experience inextricably tied to context, arguing that learning occurs as participants work collaboratively to derive meaning from experience. Within a social learning orientation, context is seen as a dynamic collection of individuals, artifacts, environments and experiences that help shape learning.

Collectively, each of these orientations to learning and their associated learning theories inform a variety of instructional strategies used in health professions education today, including problem, workplace and simulation-based learning.

Section 4: *Learning in Context* in Healthcare Education

Learning in context takes many forms in healthcare education. For example, in problem based learning (PBL), basic and medical science principles are learned within the context of clinical problems (Albanese, 2010; Onyon, 2012), drawing on both cognitivist and social learning epistemologies. From a cognitivist orientation, semantic contextual similarity (in the form of clinical problems for the learners to solve) not only facilitates recall, but also is believed to strengthen transfer by providing multiple functional contexts within which to learn concepts. Similarly, a social learning orientation would view context (the group learning setting) in PBL as facilitating interaction between learners to promote participatory learning.

In workplace-based learning, learners are immersed in actual clinical practice settings to develop technical and non-technical skills under the supervision of expert mentors and in collaboration with peers (Dornan, Boshuizen, King, & Scherpbier, 2007; Yardley, Teunissen, & Dornan, 2012). Epistemologically, this strategy draws on cognitivist theories – contextual similarity promotes recall and transfer – and social learning orientations – context facilitates transformative learning and socialization through participation in a community.

Simulation-based learning is another example of learning in context that is nearly ubiquitous with healthcare education today. In simulation-based learning, clinical practice conditions are replicated – either in whole or in part – in controlled settings to facilitate learner development through the use of *deliberate practice* (Ericsson, 2003, 2008; Ker & Bradley, 2010). Arising primarily as a means to ensure clinicians are competent and safe for entry-to-practice, simulation provides a mechanism for developing skills that PBL cannot (i.e., technical competencies) and without exposing patients to risks as might occur in workplace-based learning (Owen, 2012; Rosen, 2008).

Epistemologically, simulation-based learning draws on all three major orientations toward learning. For example, the characteristics of the simulation environment and the properties of the simulator (commonly referred to as *fidelity*) provide an important context to facilitate feedback, considered an important determinant of learning in behaviourist epistemologies. Similarly, semantic and physical contextual alignment promotes retrieval, application and transfer of knowledge, important principles in cognitivist epistemologies. Finally, simulation-based learning creates a participatory environment, encouraging interaction between learners and the environment, thus aligning with social learning orientations.

As an instructional strategy, the effectiveness of simulation-based learning has been well established. Numerous reviews have demonstrated the efficacy (and in some cases the superiority) of simulation-based learning in medicine (Cook et al., 2013; Cook et al., 2011; Harder, 2010; McGaghie, Issenberg, Petrusa, & Scalese, 2010), surgical skills (Ma et al., 2011; Zendejas, Brydges, Hamstra, & Cook, 2013), nursing (Cant & Cooper, 2010; Jansson, Kaariaainen, & Kyngas, 2013; Lapkin, Levett-Jones, Bellchambers, & Fernandez, 2010), midwifery (Cooper et al., 2012), and paramedicine (Abelsson, Rystedt, Suserud, & Lindwall, 2014; Boyle, Williams, & Burgess, 2007; McKenna et al., 2015). Simulation is particularly useful for developing complex but infrequently used skills such as those used during resuscitations (Kennedy, Cannon, Warner, & Cook, 2014; Mundell, Kennedy, Szostek, & Cook, 2013). The benefits of simulation are in part attributable to the ability of simulation-based learning to facilitate deliberate practice. Pioneered by K. Anders Ericsson, deliberate practice is an instructional framework in which learners work to systematically close gaps between current and desired performance levels by participating in effortful activities while supported by feedback from expert mentors (Ericsson, 2003, 2008).

Section 5: Research Question

Similar to students in other health professions, paramedic trainees participate in simulation-based learning as part of their entry-to-practice training. Amid growing concerns over patient privacy and safety as well as competition for scarce placement resources, paramedic educators are increasingly turning toward simulation-based learning to supplement or replace portions of clinical hours in workplace-based settings (McKenna et al., 2015), suggesting that simulation use in paramedicine will continue to grow. Paramedics practice in highly varied and often austere field conditions in settings where space, lighting, positioning, temperature, etc. are frequently sub-optimal for patient care. Similarly, emergency scenes are difficult to predict and control: environmental features might be distracting, bystanders and family members might be emotionally unstable or violent, higher levels of care (e.g., specialist clinicians) are unavailable and patients are undifferentiated. Operationalizing simulation in paramedic education requires careful consideration to issues of context, in equal parts to understand what features of clinical practice conditions must be replicated, with what degree of realism and whether such authenticity in simulation will enhance learning, as predicted by theories of learning that emphasize learning in context.

Our goal in undertaking this research was therefore to contribute to the discussion on the role of context in education by exploring contextual influences in paramedicine with the goal of developing (or contributing to) a contextual framework that can inform future experimental studies into the effects of learning in context. Our research question was: *What features present in clinical practice conditions might affect paramedic performance during resuscitation training and would be needed to realistically portray actual clinical cases in a simulation-based environment?*

Chapter 2: Methods

Section 1: Overview of Study Design

In this study, we adopted a Constructivist Grounded Theory methodology, using one-on-one semi-structured interviews with currently practicing paramedics. Our intention was to explore features present in clinical practice conditions that affected the participants' behavior in a specific subset of patients – out of hospital cardiac arrest – relating to physical features of the environment, as well as cognitive, social and emotional demands and any other features deemed relevant by the participants. We identified out-of-hospital sudden cardiac arrest as the event of interest, given the wide range of contextual influences present during resuscitations (physical tasks of care, level of acuity, emotional significance). Interviews were recorded and transcribed verbatim and subsequently analyzed using the methods of *thematic analysis* and *constant comparison* to derive cogent, explanatory themes from the data. Importantly, the constructivist grounded theory methodology (Charmaz, 2008) guided all aspects of this study (described further below).

Section 2: Epistemological Stance

We situated this research within a *constructivist* epistemological stance to frame our research question, methods and interpretation of results. Constructivism, as it relates to conducting research, embraces subjectivity and acknowledges the inherent presence and influence of the researcher in the research process (Bunniss & Kelly, 2010). In contrast to positivist – in which objectivity is paramount – methods, constructivism does not seek out a single, knowable truth or reality. Rather, constructivism assumes that knowledge, truth and meaning are constructed by the 'knower', and that individuals create their own 'reality' based on their experiences (Bunniss & Kelly, 2010; Illing, 2010). In a constructivist study, the researcher attempts to interpret the individual's 'reality' in an effort to understand the individual's experience from their perspective. Constructivism therefore assumes and embraces the concept of multiple different truths or 'realities' constructed by others (Bunniss & Kelly, 2010; Illing, 2010) and encourages different, perhaps contradictory perspectives on the research question.

Constructivist approaches are becoming increasingly common in medical education research. For example, recent investigations into the use of distributed education practices (Topps, Ellaway, Baron, & Peek, 2015), effectiveness of online instruction (Ellaway, Pusic, Yavner, & Kalet, 2014), the influence of context on workplace-based assessments (Stroud, Bryden, Kurabi, & Ginsburg, 2015) and resident learning through clinical activities (Teunissen et al., 2007) have used qualitative research paradigms with constructivist epistemologies.

Section 3: Participant Characteristics, Sampling & Recruitment

Participant Characteristics

We recruited currently practicing paramedics from emergency medical services in the Greater Toronto Area (GTA) to participate in this study. In the province of Ontario, two levels of paramedic provide pre-hospital emergency care in the community: primary and advanced care paramedics. Primary Care Paramedics (PCPs) complete a two-year community college diploma program, while Advanced Care Paramedics undergo a third year of community college training to provide certain ‘Advanced Life Support’ (ALS) interventions aimed at stabilizing the most acutely ill and severely injured patients. In Ontario, paramedics work mainly in pairs with PCPs making up the bulk of the paramedic workforce. ACPs usually work in partnership with PCPs in a PCP-ACP crew configuration. Paramedics at both levels work within a provincially defined and relatively consistent scope of practice (Ministry of Health & Long-Term Care, Emergency Health Services Branch, 2016). Continuing education requirements are typically 12 or 24 hours of classroom-based didactic instruction per year for PCPs and ACPs respectively.

Sampling & Recruitment

Our sampling strategy was theoretically guided (Creswell, 2013a) and *purposive*, seeking participants who could speak to our research objective and were accessible to the research team. Purposive sampling involves actively seeking out participants who are expected to have informative perspectives, unique experience or special knowledge related to the research question (Coyne, 1997; Marshall, 1996). Our goal in the present study was to solicit participation from subjects who could contribute meaningful and rich perspectives to the research question while staying faithful to the theoretical underpinnings of the study and our epistemological stance (Watling & Lingard, 2012). This involved approaching paramedics with a wide range of clinical experience to participate in the study, from novice paramedics who had only attended a small number of cardiac arrest events to much more experienced paramedics who had attended many. Additionally, we were interested in soliciting participation from both primary and advanced care paramedics and paramedics with teaching responsibilities (either as faculty at an institution or as field preceptors).

Recruitment occurred via three mechanisms: (a) an invitation to participate in the study was distributed via workplace email to paramedics; (b) participation was solicited via posts on common social media platforms including Twitter and Facebook; and (c) informal recruitment occurred through word of mouth and passing conversations. In all cases, solicitation included a brief explanation of the study’s purpose, methods, time commitment and mechanism for scheduling participation.

Inclusion criteria included: (a) currently practicing paramedic; (b) has participated in the attempted resuscitation of a cardiac arrest patient within the past six (6) months; and (c) recalls the event in sufficient detail to describe it to the researchers and answer questions about the event. These criteria were chosen to satisfy the research question, specifically to solicit participation from subjects who could describe contextual influences present in clinical practice settings, recognizing that the participants might not necessarily be positioned to situate their comments within education theory. There were no specific exclusion criteria.

Sample Size

Qualitative studies do not lend themselves to a priori sample size calculations and in the present study our sample size was determined theoretically with recruitment continuing until saturation was achieved (see subsequent sections on data collection and analysis). *Saturation* describes a thick description of the phenomenon of interest, a point at which redundancy is apparent in the themes identified and reflects a conscious decision on the part of the researchers to halt data collection (Watling & Lingard, 2012).

Ethical Issues

This study was approved by the Centennial College Research Ethics Board (REB Application #246). Prior to participation, all subjects received a briefing that included the purpose of the study, an explanation of the relevant background information, the expected time commitment and the methods involved in the study. Importantly, we acknowledged that participation in this study did involve a risk to the participants.

Specifically, we acknowledged that asking the participants to recall a cardiac arrest event might trigger psychological distress in the form of flashbacks and/or feelings of anxiety. We took this risk seriously, particularly considering the current discourse in the media describing Post-Traumatic Stress Disorder (PTSD) and suicide among first responders (Kohut, 2016; Tema Conter Memorial Trust, 2016). In attempting to ameliorate this risk, we informed the participants that their participation was entirely voluntary and we encouraged them to be honest about the feelings they were experiencing during the study. Our intention was to halt the interview if, at any point, the participant disclosed that they were experiencing – or the researcher believed they were experiencing – an acute stress reaction. The researcher was prepared to support participants who experienced psychological distress by providing access to crisis counseling centers. In addition, Employee Assistance Programs (EAP) were available to all participants through their respective employers.

Once the participants were satisfied that they were fully informed, they signed forms indicating their informed consent to participate in the study. These forms were retained by the researcher and an electronic copy was emailed to the participant after participation.

Section 4: Data Collection

Demographic Data

We asked participants to complete a demographic questionnaire. The questions included the participant's age, gender (as identified by the participant, acknowledging this may differ from biological sex), provider level (PCP or ACP), place of employment, years of experience and estimated annual exposure to cardiac arrest events. We also asked about whether or not the participant held any teaching responsibilities either as faculty at an educational institution (e.g., a community college or clinical oversight body) or as a field preceptor providing workplace-based learning for paramedic trainees. We used this data in part to drive our theoretical sampling strategy to ensure representation from a variety of experience levels, classifications of providers and genders.

Interviews

For the purposes of our study, the unit of analysis was a cardiac arrest event, as described by the participant. Due to the ethical and logistical challenges of observing actual clinical practice conditions in pre-hospital settings, we asked paramedics to participate in one-on-one semi-structured interviews with the intention of exploring the event in detail. While direct observation may have been methodologically more desirable, inserting a researcher into the pre-hospital setting to attend cardiac arrest events poses a number of important challenges including the role of the researcher during the resuscitation (i.e., they may be required to intervene), the safety of the researcher and issues related to informed consent. We therefore selected semi-structured interviews our method of choice to achieve a reasonable balance between (logistical and ethical) feasibility and richness in data collection, recognizing some important limitations (see Chapter 4, Section 5). Semi-structured interviews are common tools for data collection in qualitative research (Lingard & Kennedy, 2010) and were selected for their ability to explore events in detail using an interview guide (see [Appendix 1](#)) while maintaining the ability to explore novel information serendipitously (Lingard & Kennedy, 2010). Our intention was to interview each participant once, however some participants indicated a desire to be interviewed again in the future if they attended a cardiac arrest event after the initial interview. This occurred in the case of three participants (see Chapter 3, Participant Characteristics).

The interview guide was derived through consensus with input from all members of the research team. Our intention was to explore a cardiac arrest event with enough granularity to identify any/all influences of context as reported by the participant. In structuring the questions, we were guided by the theoretical underpinnings of the study, drawing on social learning theories (Durning & Artino, 2011; Kaufman & Mann, 2010; Woolley & Jarvis, 2007), principles of cognitive psychology related to transfer (Barnett & Ceci, 2002; Cowan, 2014; Craik & Lockhart, 1972) and finally features that might relate to feedback (Ericsson, 2003; Sigrist et al., 2013). Collectively these theoretical

perspectives served as *sensitizing* concepts during data collection in that they oriented the researcher to the research question and relevant theoretical perspectives but without contributing empirical data that might influence the interpretation of the results (Bowen, 2006). Finally, the questions in the interview guide were structured to be deliberately broad and open-ended, with the intention of allowing the participant to respond whatever manner they saw fit. Our intention was to conduct interviews in a casual manner and conversational tone to promote comfort and encourage openness.

Interviews occurred at a mutually agreed upon location, most commonly at an emergency medical services station or headquarters facility but other locations included coffee shops, restaurants and participants' residences. In all cases, we made efforts to ensure that the interview occurred in a quiet setting, free of distraction with both the participant and the interviewer seated comfortably. During the interview, the researcher recorded hand written notes using the memo writing technique – a process of recording observations, insights and reflexive thoughts during data collection and analysis (Kennedy & Lingard, 2006; Watling & Lingard, 2012). Memos written during interview were intended to flag ideas for subsequent follow up, describe emerging themes, ideas and concepts and finally to document the researcher's reflective commentary on the data collection process as a method of reflexivity (described further in Section 6). The written medium was chosen primarily for its ability to be minimally intrusive (i.e., a small notebook), while others might have chosen an electronic medium such as a computer or tablet. Additionally, the hand written method offered the further advantage of allowing the participant to draw a sketch of the scene, thus providing a common point of reference between the interviewer and the participant during the interview.

All interviews were recorded using the researcher's phone (Apple iPhone 5s) using the 'voice memo' application. This application provided a convenient ability to record conversations using the phone's built in microphone with a high degree of reliability. The recordings could subsequently be transmitted electronically to the researcher's computer and the original recording deleted.

Section 5: Data Analysis

We followed the techniques of constructivist grounded theory as espoused by Charmaz (Charmaz, 2008). As a methodology, grounded theory is an iterative approach to data analysis as analysis of data occurs simultaneously with and informs data collection in an organic fashion (Creswell, 2013a; Kennedy & Lingard, 2006; Starks & Trinidad, 2007; Watling & Lingard, 2012). We first provide a historical context to consider the evolution of the methodology before describing our specific methods.

Grounded Theory Methodology

Grounded theory, as research methodology, has its origins in positivist epistemology and was originally described by sociologists Barney Glaser and Anselm Strauss in the 1960s

as a method to qualitatively explore phenomena through rigorous iterative data analysis, with the (at the time) unique intention of generating theory *from* data (Watling & Lingard, 2012). As a methodology, grounded theory was appealing to a wide variety of scientists in part due to its methodical, structured approach to data analysis and attention to standards of internal and external validity; principles considered essential elements within positivist research paradigms (Kennedy & Lingard, 2006). At the time, qualitative research methods were considered subordinate to quantitative methods and the work of Glaser and Strauss served to legitimize qualitative research by creating a methodology that bridged the gap between the two paradigms (Lingard & Kennedy, 2010; Watling & Lingard, 2012). It wasn't until later that constructivist interpretations of grounded theory emerged.

Charmaz is credited with establishing the constructivist (although she describes it as 'constructionist') method of grounded theory research. The key differences between traditional and constructivist grounded theory relate primarily to the role of the researcher in data collection and analysis. In the traditional interpretation, and in the positivist tradition, the role of the researcher is de-emphasized with an emphasis on objectivity and minimizing bias. In contrast, the constructivist interpretation acknowledges the influence of the researcher in the research process, arguing that knowledge, meaning and truth are socially constructed entities. Charmaz describes constructionist grounded theory in the following set of guiding epistemological principles:

“(1) Reality is multiple, processual, and constructed ... (2) the research process emerges from interaction; (3) it takes into account the researcher's positionality, as well as that of the research participants; (4) the researcher and researched coconstruct the data – data are not a *product* of the research process, not simply observed objects of it”
(Charmaz, 2008, p. 402)

We adopted this interpretation to remain faithful both to our epistemological stance on the research question (i.e., learning as a social endeavor) and also because of constructivist grounded theory's ability to “explicate a social process” by viewing data within its context (Charmaz, 2008). Constructivist grounded theory has since been recognized as one of the most common approaches – either in whole or in part (i.e., Kahlke, 2014) in qualitative research in medical education (Lingard & Kennedy, 2010; Watling & Lingard, 2012) and the social sciences (Creswell, 2013a).

Data Preparation

In preparing the data for analysis, we undertook the following steps: (1) recorded interviews were electronically transmitted to the researcher's computer for transcription; (2) the researcher transcribed the participant's statements, utterances and pauses verbatim, taking care to maintain the original flow of speech; and (3) transcripts were saved as

Microsoft Word (Microsoft Inc.) documents and were imported into NVivo for Mac 11 (QSR International) for analysis.

Coding & Analysis

Once imported into NVivo, transcripts were analyzed using the open coding technique (Kennedy & Lingard, 2006; Watling & Lingard, 2012). This analysis method involves categorizing the statements of the participant into broad categories using conceptual and theoretical similarity. After open coding was complete, axial coding was used to further clarify the relationships between emerging themes and categories, organizing the themes into hierarchical relationships related to conceptual similarity. Finally, selective coding was used to shape the data into cogent, explanatory themes, providing a theoretical explanation for the observed results to be situated within the broader literature (TKennedy & Lingard, 2006; Watling & Lingard, 2012). During all stages of analysis, we employed a constant comparative method (Watling & Lingard, 2012) in which emerging themes and concepts are compared iteratively to the underpinning theoretical perspectives on the study, the research question and finally to the data itself, actively seeking confirmatory and dis-confirmatory perspectives. One researcher (JM) was responsible for all coding.

During analysis, the researcher reflected critically on the emerging narrative, comparing the responses of the participants to the questions contained in the interview guide, making minor adjustments (mostly related to phrasing of questions) as necessary. This process of data collection and analysis continued cyclically until theoretical saturation was achieved, that is, no new themes were identified and the researchers were satisfied with the richness of the data. Only one structural modification to the interview guide was made, occurring approximately halfway through data collection and was intended to explore the emerging concept of ‘humanizing’ factors within encounters.

Section 6: Reflexivity & Trustworthiness

Current standards for reporting qualitative research results (i.e., O'Brien, Harris, Beckman, Reed, & Cook, 2014; Tong, Sainsbury, & Craig, 2007) advocate for detailed explanations of how reflexivity and trustworthiness are maintained throughout data collection, analysis and presentation. Creswell (2013c) suggests that reflexivity has two overlapping and important components: (1) the researcher must disclose their past experience with the phenomenon being studied; and (2) the researcher must demonstrate a critical self-awareness of how these past experiences, including preconceived values, attitudes, beliefs, influenced the findings and interpretations of the study. We report on the relevant variables here.

Researcher Characteristics

The principal investigator is a currently practicing paramedic with Peel Regional Paramedic Services, a faculty member in the School of Community and Health Studies at

Centennial College with teaching responsibilities in the paramedic program and a graduate student with McMaster University. Each of these ‘professional identities’ contributed to the implementation of this study in various ways.

As a paramedic, the researcher brings a clinician’s perspective to the research question regarding the influence of contextual features on learning and performance. Having been exposed to hundreds of cardiac arrest during his 11-year career, the researcher is keenly aware of contextual features that influence *his* performance during resuscitations. These very real clinical experiences, in part, led to questions regarding optimal instruction, particularly with respect to simulation-based learning.

As a faculty member, the researcher has experience with simulation-based learning in various forms, including the use of partial task trainers, human patient simulators, and immersive simulations. The fundamental question for the researcher has been whether authentic simulations – those that carefully recreate clinical settings including their physical, cognitive and emotional characteristics – would result in improved learning. This intersection between clinical experience and education theory is what primarily drove the researcher to pursue this line of inquiry.

As a graduate student, the researcher was able to blend both the clinician and educator perspectives to formulate a research question, supported by experienced faculty supervisors and sensitized appropriately by the guiding theoretical lenses described earlier. From a practical perspective, the researcher’s professional affiliations proved advantageous in recruiting participants, providing both credibility as a peer and access to resources to conduct recruitment (i.e., employer email lists). This allowed the researcher to conduct the study as an accepted member of the community, an important principle of social learning wherein the influence of the community is considered formative (Hodges & Kuper, 2012; Mann, 2005, 2011).

Reflexivity

In an effort to maintain a reflective self-awareness during the study, the researcher engaged in the following methods intended to illuminate the influence his previous experiences, attitudes, values and beliefs may have had on the collection and interpretation of data: the researcher engaged in reflective journaling after both the participant interviews and subsequently during analysis. This was done by hand with the researcher writing a detailed (1-2 page) reflection after the analysis was complete for each interview, reflecting on the comments made by the participant, the emerging themes and how these related to the research question and the perspectives of the researcher.

At times, this process identified areas of uncertainty related to process (i.e., how to pursue emerging areas of inquiry) or interpretation (i.e., the inferences drawn from the participants’ statements) and the researcher held regular meetings with his supervisor and committee members to discuss these issues.

Trustworthiness

Qualitative studies do not lend themselves as neatly to the constructs of internal and external validity found in quantitative research; rather, qualitative researchers are concerned with the *trustworthiness* (referred to as validation by some) of the results and interpretation (Creswell, 2013b). While standards vary among authors, we engaged in the following measures to promote trustworthiness during this research study:

1. We adopted a research methodology that is well established and remained faithful to its principles and methods during all phases of the research
2. The researcher participated in frequent “debriefing” sessions with the thesis committee and supervisor (discussed earlier in reflexivity)
3. We were careful to be transparent about the “insider research” perspective on the research question through reflective commentary during the research process
4. We continued data collection and analysis until we achieved a thick description of the phenomenon of interest; that is, no new themes were identified in the data and there was consensus among the research team that data collection could halt.
5. The researcher maintained an explicit audit trail describing all decisions made during the study and articulating supporting rationale

These criteria were derived from several sources (Creswell, 2013b; O'Brien et al., 2014; Shenton, 2004), acknowledging that other strategies for ensuring trustworthiness (e.g., triangulation of data from multiple complimentary perspectives) were not followed due to logistical constraints. This is discussed further in the limitations section (Chapter 4).

Chapter 3: Results

Fourteen informants participated in the study with three participants providing a second interview, representing a total of 17 distinct events for analysis. The average interview length was 34.5 minutes (SD 10.8) yielding a total of 587 minutes of audio data for analysis.

Our participants were mostly female (64%) and were mostly primary care paramedics (57%). The participants had an average age of 32.4 years (SD 4.8) and reported an average of 7.6 (SD 5.4) years practicing as paramedics and an average of 5.7 (SD 3.8) years practicing at their current level (i.e., for advanced care paramedics). Eight (57%) of our participants identified teaching responsibilities in paramedic education either as institution faculty or as field preceptors. Our participants reported attending an average of 10.2 (SD 6.9) out-of-hospital cardiac arrest events per year during their duties as paramedics. With the exception of 2 paramedics, all participants identified Peel Regional Paramedic Services as their primary institutional affiliation. Demographic characteristics are presented in [Table 1](#).

In considering contextual influences during out-of-hospital cardiac arrest, we iteratively identified three major themes: *the event*, *the conceptual response*, and *the emotional response*. We identified a fourth theme (*simulation elements*) related to how to recreate these experiences in simulated settings. Each major theme had a number of subordinate themes; all are discussed in detail below. We provide a graphic representation of our results in [Figure 2](#). To protect the participants' identities, we have substituted gender and culture-appropriate (i.e., to provide the reader with insight into the demographic spread of the participant statements) pseudonyms for the participants' real names.

Theme 1: The Event

Our participants described a number of features that can be broadly classified as relating to the event itself, most often relating to the physical characteristics of the environment and the people present. These included *the context of the event* (what happened), *characteristics of the scene*, *characteristics of the patient*, and *'others' in the environment*.

Context of the Event

The participants often began the interview by describing the events and circumstances leading up to the activation of the emergency response system and their subsequent involvement. The participants tended to frame the conversation using these details of the event. In addition to 'setting the stage' for the interview, these details appeared to inform a clinical gestalt around the anticipated clinical course for the patient, offering some prognostic information (discussed further in the *conceptual response* theme).

“We were dispatched for a 45-ish, mid-forties anyway, year old male who had a witnessed cardiac arrest by his wife in an apartment building. So we show up, arriving at the same time as fire ... and we were met at the door of the apartment by the patient’s wife ... (who) directed us to her husband who was in the bedroom ... and was lying um supine (face up) and completely naked on the bed. I don’t know who got the information, it wasn’t me, but one of the firefighters who I guess had taken the wife aside because she was panicked, came in to the room behind me ... and felt that it was necessary to tell me immediately that he (the patient) died while having sex.” (‘Carm’)

“Yeah, so (this) 70 year-old man just began to not feel well, no significant medical history, collapsed to the ground, went unresponsive. The son-in-law, I believe, was at the house. He was trained in first aid and started CPR prior to our arrival” (‘Kristina’)

Specific elements of the events – the patient’s collapse being witnessed, a bystander initiating or attempting cardiopulmonary resuscitation (CPR) – were often interpreted by the participant to suggest an improved chance of survival for the patient. The same was true for circumstances suggestive of a less favourable outcome:

“So it looked like it was a single vehicle (motor vehicle collision). This area of the 403 (freeway) is a really dangerous area ... at the time we didn’t really know what happened it didn’t look like she was drunk or anything like that, it looked like it was mostly just speed and she lost control and flipped the car, the car was just mangled to bits. ... When we were pulling up, we saw her skid marks from here (referencing diagram) so I think she panicked and then hit the pole, so the car is smashed to bits over here (referencing diagram) and this is the pole (referencing diagram), it (the car) was maybe 10 feet away from the pole, like it friggin’ bounced. Like she must have been flying and hit that pole. ... I think she made a mistake, I think she thought she missed her ramp or she ‘speed wobbled’ and then panicked.” (‘Marcy’)

“So it was a suicide – we’re not exactly sure of all the details – initially, we were told hanging and then more specifically, we think it was just strictly asphyxia with a belt ... we think she just leaned forward into the belt.” (‘Samantha’)

Collectively, the circumstances of the event framed the conversation in two important ways: first, it situated the event within a specific experience, providing a point of reference for the rest of the ‘story’ to unfold. Second, the participants would refer back to the circumstances of the incident when articulating their estimation of the patient’s probability of survival, suggesting these details inform a clinical gestalt related to the

patient's prognosis with certain factors – witnessed arrest, bystander CPR – suggesting survival and others – traumatic cause of arrest, asphyxia – suggesting poorer outcomes.

Scene Characteristics

The participants provided several descriptions related to the physical characteristics of the scene and discussed how these enhanced or detracted from optimal patient care, often citing the austere conditions germane to pre-hospital care.

“They (the patient and his wife) had just moved in and the place was incredibly cluttered, there were many boxes, many items of furniture kind of like stacked up in the hallway and in the bedroom. There was nowhere to ... place to the patient on the floor in the bedroom. So we decided pretty quickly we were going to pick him up and fore-and-aft (a type of emergency patient carry) him off the bed ... unfortunately as we carried him out of the bedroom into the hallway, we realized there was nowhere to put him down, and (we) carried him from the hallway to the entranceway and there was nowhere really to put him down there either, so in the end ... it was me and a firefighter and we ended up carrying him right out of the unit and right on to our stretcher in the hallway. Which is not normally, I don't normally, advocate extricating a cardiac arrest (patient) with no CPR in progress right to the stretcher.” (‘Carm’)

The participants described situations in which care plans had to be modified to perform interventions in the face of prohibitive environmental conditions, often requiring careful choreography of team members.

‘Joanna’: “It (the bedroom) was small. ... There was enough space beside the bed for the patient to lie supine and for 1 person to kneel at her side.”

JM: “Enough for you to work comfortably?”

‘Joanna’: “No we weren't able to access the patient from both sides and it was quite cramped for the person at the head ventilating. They were sort of sitting on their own feet and smushed in there, when it came time to switch CPR operators, one had to get out of the way before the other could step in versus being able to take over from the opposite side of the body.”

Another participant offered:

“The space issues were definitely a challenge because it changed the way we kind of had to ... configure our team ... I think the biggest

thing was we were almost tripping over each other. Actually my partner made a comment afterwards that if we were playing “Twister”, we would have done very well” (‘Mark’)

Participants also made reference to lighting:

“The bedroom had very poor lighting. There was no overhead light, there were a couple of fairly dim table lamps, so the lighting in the room was very poor... Fire had to use a flashlight to try and provide additional lighting, especially for the IV and things like that because the lighting was actually so poor that we actually couldn’t see what we were doing, even just being able to read the labels on the, like, the lighting was so bad to read the medication labels and doses” (‘Mark’)

Others made reference to distracting smells or noises in the environment:

“There was a dog barking the entire time. The dog barking just stands out because it was a very shrill, very loud dog that made it very hard to hear when we were trying to communicate. She (the patient’s wife) was screaming constantly in the background, all kinds of friends and neighbours were around so it was a very noisy environment. When we were trying to give very clear directions and you know when we talk about effective communication, it’s very hard to do when there’s constant noise” (‘Mark’)

“Sometimes they (patients) vomit and the smell is very potent because you’re in an enclosed area and the smells add to it ... it adds an element to your nausea too, because it doesn’t smell good, it’s just (non-word vocalization describing noxious smell) ... It’s very distracting.” (‘Sabrina’)

In summary, the participants described physical features of the environment – confined spaces, poor lighting, distracting noises or smells – that made providing optimal care challenging, suggesting that these features require improvisation to overcome. Not all of the events described in this study had these challenges; in some events, the participants described conditions in which space, lighting and temperature were ideal, however this is difficult to predict and often not under the control of the paramedics. This also suggests that where these features do not constrain patient care directly, they are still being actively considered by the paramedics.

Patient Characteristics

The participants provided many descriptions of the physical features of the patients, including the patient’s age (whether known or apparent), sex, and defining characteristics.

Very often, the participants would speak to the patients having a ‘lifeless’ appearance that was readily identifiable:

He looked obviously VSA (vital signs absent), it wasn’t one of those ones where we should check a pulse, it was like ‘Oh, he’s dead’. As opposed to some of them where, you’re like ‘hmm, maybe we should check a pulse on this guy’, he just had that...look. He was definitely apneic (not breathing), which adds to the lifelessness, pallor for sure, almost cyanotic (blue tinge) to the lips, but not, almost like a mix of pallor and cyanosis, um zero, like zero muscle tone. I want to say that even when people are unconscious or asleep, they’ve got almost like a facial tone, there’s some muscle tone in their face, this was nothing. That’s where I think you notice it, that complete lack of muscle tone on their face and often times they have those...eyes that are open just like 3 or 4mm, like slits. It was definitely as soon as we walked in, we could tell that he was dead.” (‘Carm’)

Other times, the patient’s physical appearance would provide clues as to their underlying state of health:

“She did not look healthy, she had poor hyg – um oral – hygiene. She had bad teeth. Umm, I found like her eyes were open and she just looked ‘dead’ before we even started working her. Her eyes had clouded over, like the life was just gone.” (‘Sabrina’)

The participants also commented on situations in which the patient’s appearance – or defining physical characteristics – made optimizing care challenging:

“(Exasperation) My second IV (intravenous line) just slid right out (because the patient was very sweaty) ... I just taped it (the IV) right around and I just watched it slide out and was like ‘Well that was terribly unfortunate’.” (‘Shawn’)

“Just his physical size and the shape of his torso was unique – you actually couldn’t kneel beside him, you had to almost stand to do the CPR but even just the downward slope of his chest made the CPR compressions a bit more difficult.” (‘Mark’)

In some cases disturbing physical features served as a distraction to team members:

“She had significant left sided facial trauma, and her right mandible was fractured, also to add to that, she had (an) obvious deformity to (her) c-spine. There was a lot of blood coming from her airway, so upon ventilation after my partner intubated, probably every time we

ventilated her or fire doing CPR, we had blood coming from nasal, oral airway, so I had to suction, so it was pretty much just blood spurting all over the truck and the firefighters” (‘Kacey’)

“The firefighters kept wanting to stop doing compressions because they said ‘He’s alive!’ and I said ‘No, continue with the 2 minutes.’ They kept saying ‘He’s moving, he’s alive’. He would have some respirations, sort of not completely on his own, but enough – like you could feel that there was some sort of organized respiration, but then again it would just stop as soon as we’d stop compressions.” (‘Kristina’)

In summary, these physical features appeared to provide important clinical information (such as the age and apparent health of the patient), aid in the recognition of cardiac arrest (the ‘lifeless’ appearance) or in some cases, appeared to complicate care (i.e., through distracting physical features).

Others in the Environment

The participants made frequent reference to others present during the events, noting that cardiac arrest incidents tend to be highly populated scenes with family members and other bystanders present. In some cases, the presence of ‘others’ was perceived to be distracting.

“I more noticed them (a group of media who had gathered at the scene) when I was heading toward the truck (ambulance) with her (the patient), I noticed them and I hoped they weren’t taking pictures of us doing CPR on her and then when I left the truck (ambulance), I noticed them more and I was like ‘Wow!’ There was like 5 people with cameras and I was like ‘Holy crap!’ It was distracting.” (‘Marcy’)

This was particularly the case with respect to bystanders or family members who were emotionally distraught and whose (often volatile or unpredictable) emotional state proved distracting.

“So my partner started CPR while I got the (defibrillator) pads out. At that time the wife became very upset with us and the patient and began to, yeah...She was upset with everybody. She did not understand what we were doing because she kept saying that he was just “having a frenzy”, yeah a “frenzy” – her exact words – and that he did this all the time and he’d be fine in a minute. At that point while I was trying to attach the defib pads and my partner was still attempting to do CPR, she began slapping the patient in the face repeatedly. Umm, which was needless to say a gigantic distraction and we were trying to get her to

stop without causing a delay to patient care at that point too, because no one else was on scene even” (‘Mallory’)

“Just as we delivered the first shock, the daughter of the patient screamed and ran to throw herself on the patient and the fire captain um, I think he was just having a bad day, uh yelled at her and swore at her and told everybody to get out of the room and get into the kitchen.” (‘Shawn’)

Some participants suggested the emotional state of others present, particularly family, might impact the clinical care of the patient, or influence their decision-making when considering whether or not to terminate resuscitation:

‘Shawn’: I just have that conversation, make sure everybody’s on board ... that family’s ok with a pronouncement, or the family’s not coping well”

JM: “Does that influence your decision? Pronouncement vs. transport?”

‘Shawn’: “It’s always in my mind that it would, but it hasn’t yet, do you know what I mean?”

JM: “Which one would win?”

‘Shawn’: (chuckles, shrugs) “Clinical.”

The presence of other people, particularly other first responders, necessitated social engagement, requiring the participants to work collaboratively to optimize care during a high acuity resuscitation. This was normally accomplished smoothly as a result of their training; however, the participants commented on an underlying tension if they were working with a particular individual for the first time.

“It was interesting because the individual ... basically my partner on this call, I had never worked with before. We hopped into the – an – ambulance (at the hospital) and paired up together because it (the call) was close the hospital that we were at so it was sort of an interesting aspect of it was this fact that I’ve not worked with this person before and potentially that can create a source of um...disorganization on a call when two partners aren’t necessarily used to working together ... because I know how I would run this call if it was my regular partner, but whereas with this one, I’m not sure, ‘Ok, how do they like to set their bag up, where do they want the stuff’ and you know...” (‘Samantha’)

The participants commented that paramedics depend on establishing positive and close working relationships with their colleagues, a social nuance that occasionally conflicts with the necessity to work collaboratively to optimize care during high acuity calls, often in ad hoc team configurations. The participants would comment on how the personalities of the people present would affect the social dynamic of the resuscitation.

“He’s (referring to another paramedic present) just a difficult person, we’ve just had problems with him in the past. Yeah, I don’t agree with a lot of the things he does on calls, he gives a lot of attitude to family, to fire, and to us. Um, at times, he’s just a difficult person. Like, usually it’s just all positive and I don’t have any ill thoughts about anybody, my mind is on the job, but you know, with this guy, I was like ‘Ah sh*t, you’re here’. Sorry.” (‘Shawn’)

“It keeps the tone of the arrest calm, but if you, if you’re like the leader, the ALS, the head medical is freaking out, it gets your back up a little bit too, if you’re being barked at, it’s like ‘Well wait a second here, why are you barking at me? I’m just trying to help you’. You get a little angry” (‘Sabrina’)

The participants emphasized the influence that ‘others’ in the environment had on the resuscitation, noting that paramedics are required to work collaboratively with other responders to optimize care. These interactions – with bystanders, family members and other responders – were perceived both positively (i.e., a situation in which everyone works well together) and negatively (i.e., distracting bystanders or interpersonal conflict) suggesting that these social elements evolved organically and often unpredictably.

In closing, our participants shared a rich description of many of the physical features of the environments in which these cardiac arrest events occurred, describing the circumstances of the event, characteristics of the scene and patient and describing ‘other’ people present. Collectively, these physical features appeared to influence the participants’ responses to the event itself in ways that we have broadly categorized as conceptual and emotional.

Theme 2: Conceptual Response

Our participants discussed a number of themes that can broadly be considered conceptual in nature, referring to specific cognitive processes (i.e., judgment) and demands that emerged as a result of the event itself. We review each in detail below.

Cognitive Demands

The participants often made reference to specific decisions that had to be made regarding how to optimize care in the face of sub-optimal field conditions, a product of the physical features of the event itself:

JM: “What were you thinking about initially?”

‘Carm’: “*Lots*. The first decision right away: do we start compressions on the bed because it’s going to take us thirty seconds to get this guy out to where we can start CPR, or do we eat that thirty second delay now, because I don’t know how long it’s going to take to clear enough space near by, and fore-and-aft him out to somewhere where we can do CPR.”

In other cases, the participants would comment on the complexity of the event and the necessity to simultaneously perform several tasks while mentally working through complex clinical questions related to the patient’s condition and treatment. For example, ‘Mark’ discusses the process of considering an overdose as a possible aetiology of his patient’s cardiac arrest while simultaneously coordinating the resuscitation.

“He had also consumed the better part of a 24-pack of beer over the course of the afternoon and then he had his immovane – his sleeping aid – at that point there was a bit of a discussion of a possible overdose. We were pulling out his pill bottles, there were two recent prescriptions that had been (filled) one from a few days prior and one from two weeks prior and both bottles were empty and each one should have had 60 tablets of the maximum dose of Immovane – the 7.5mg – Police then informed us he had a history of suicide attempts and ideation in the past so now there was a question of umm of whether or not this had been an intentional overdose and certainly with that number of pills missing it was consistent.” (‘Mark’)

Often the participants would point out that simultaneously performing various psychomotor tasks (inserting intravenous lines, intubating the patient, administering medications) and maintaining an awareness of the clinical details was challenging. This was particularly evident in situations where environmental features (i.e., bystanders, other responders) were distracting.

‘Carm’: “The firefighter that had asked her (the patient’s wife) a few questions on my behalf (and) just kept kind of coming out with little spurts of information, kind of one sentence at a time, perfectly timed at about 10 seconds apart”

JM: Was that difficult to hear – not just hear – but also to listen to what he was saying?

‘Carm’: “At times; it depended on what I was up to. ... You know, while I was starting the IV or while I was intubating, ... I did have to ask twice at times.”

The participants also commented that the ‘busyness’ of the event distorted their perception of time during the resuscitation:

“The patch (phone call to a base hospital physician) felt like it took a long time, a very long phone call. But I think it was also because I was like ‘Oh my God there’s so much blood in her airway, I keep suctioning and it keeps coming back’. (‘Kacey’)

“Like I have no idea how long we were on scene, I’m sure it was a long time. I have no idea though. ... I feel like it went fast but then, but then the period of actually extricating her and getting her on the board and strapped felt like it took forever.” (‘Marcy’)

In summary, the cognitive processes described by the participants – relating primarily to decision-making – appeared to be influenced by features of the event, including the presence of distracting bystanders, ‘busy’ environments, or the challenges of providing optimal care in sub-optimal settings.

Balancing Dual Roles

Our participants spoke specifically about the challenges of balancing the clinical care of the patient with the need to (often simultaneously) manage the emotional responses of bystanders and family members present during the resuscitations.

“It weighed on my mind that we had this husband who had sort of vanished from the room because of (lack of) space, just standing out in the hallway and I really didn’t know if he had called anybody, if he had anybody, and at no point were we able to communicate with him (because of a language barrier), so it weighed on my mind that he’s out there, has no idea what’s happening and we just kind of stepped into his home and had taken over. It was on my mind, I was sort of eager to get a resolution to that, to find someone that could communicate with him to get some answers, both for his peace of mind and also just to gather more information.” (‘Joanna’)

I think the more challenging part really was the psychosocial aspect of umm of playing counsellor at the same time that I was playing paramedic ... I didn’t have that opportunity to really just go in to ‘Medic Mode’ and just deal with the call and then shift gears into ‘Empathy Mode’” (‘Mark’)

“This was relentless, this was every chance every time that I thought I had a minute to focus on what I was doing again, she (the patient’s wife) was coming back down the hall.” (‘Carm’)

Attending to both the clinical needs of the patient and psychosocial needs of the bystanders and family members appeared to weigh heavily on the participants, particularly if other circumstances (e.g., confined spaces, poor lighting, awkward positioning, noise) made performing clinical tasks challenging.

Gestalt & Prognostication

The participants articulated a sense of clinical gestalt about the patient’s chances of survival, informed in part by clinical variables and in part by features related to the event itself. These included various clues suggesting a shorter ‘down time’ (i.e., skin colour and temperature), the apparent baseline health of the patient and the circumstances leading up to the patient’s cardiac arrest.

“From what we gathered, it was a witnessed arrest and uh she didn’t show any signs of obvious death. That being said, she was quite frail, quite emaciated. There was a grab bar beside the bed. She didn’t appear to be in the best health. ... I think it might have been a hospital bed. So there were other things about the room, I think there was a folder with some paperwork from a hospital or facility. There were just a few things about the room that just gave me the feeling that, again, she wasn’t in the best of health. ... Early on we sort of determined that that we wouldn’t be setting up the stretcher, that we would be heading in the direction of a pronouncement (of death).” (‘Joanna’)

Because of his reaction (describing a patient showing signs of life during CPR), we decided we were going to transport, sort of earlier than later, just because there was – there was something – he was shockable, he was having some kind of reaction, so we made a transport decision sort of earlier than later...He was warm; he was very freshly VSA (vital signs absent). I call it ‘New Dead’...The ‘fixable’ dead.” (‘Kristina’)

When asked how these impressions of viability factored into the resuscitation, our participants had mixed responses:

“I’ve done calls where an individual looked more sickly, I don’t think there was any less care to them versus more care to this patient because of an appearance difference. I feel like sort of maybe you make judgments like ‘ok, this person is sort of not going to make it, so this is where we’re going to go with the call’ but that doesn’t always mean that

individual follows that path. So, so, yeah, I don't feel like there's any difference" ('Samantha')

"I think so, I think if the person's warmer or fresher or, you know, in a shockable rhythm, you feel that urge to save. You know, witnessed arrests I get amped up – which for me is not very – but I feel more energetic, more vigorous with my resuscitative efforts in the sense that it feels very time-sensitive, it feels like 'we can get this person back', ... so I find that I am more aggressive with my treatments or even just my thought process in those first couple of minutes versus one like this where you just go through the steps." ('Joanna')

"I think everybody's more on board (if the patient is perceived to be viable). Yeah. I feel like people work harder, without any prompting." ('Shawn')

In closing, our participants articulated a number of themes that we categorized as conceptual reactions to the features of the event. Some of these responses were positive – a sense of urgency when presented with a patient perceived to be viable – and others were not – difficulty balancing competing demands. In either case, these responses appeared to be products *of* the event itself, influenced by a multitude of factors related to the patient, the environment, and the context of the event.

Theme 3: Emotional Response

We identified a number of themes that can be broadly classified as relating to emotional responses. These included feelings of frustration or tension, reactions to 'humanizing' influences in the environment and perceptions of personal ownership or responsibility over the circumstances in the event. We describe each in more detail below.

Sources of Frustration or Tension

The participants related a number of examples where details of the event were unclear or were changing rapidly during the resuscitation of the patient. These instances created cognitive challenges (i.e., in attempting to ascertain specifically what had happened) and also elicited feelings of frustration.

"The cops came and were like like 'Can we identify her?' Cause they had two IDs (pieces of photo identification) and they were two different names and we were like 'Holy crap! Like which one is her? Is there someone else in the car?' ... So then we had to go back and search the ditch beside it (the patient's car) to look for a second patient in front of the media. It was like 'Oh God, this looks so bad', imagine like we pull out a second girl from this car." ('Marcy')

Maybe just the sheer shock ...like how we felt, just going from ‘Code 3’ (the call was misclassified as non-emergency) to arguing with the wife (at the front door of the residence) because she was so adamant there was nothing really wrong and he just needed to go to his appointment, to finding him VSA (vital signs absent), just how quick – I mean things change quickly all the time for us – but that went from...it escalated so quickly and in such a random way, I don’t think I’ve ever had...it was like a whole other level” (‘Mallory’)

The participants also expressed feelings of frustration where disagreements over care arose during the resuscitation. These disagreements occurred for a variety of reasons, including when the beliefs of the attending paramedics conflicted with the wishes of the family regarding resuscitation:

“I would say the family members and how they were responding to their ... umm, to our patient, I do remember the ACP asking the family members if she had a DNR (do not resuscitate order), she didn’t, they wanted everything done on her....she was not very healthy looking, which came – which is why, when she didn’t have a DNR – it somewhat came as a surprise to us.” (‘Jeremy’)

Disagreement over care also arose between responders during the resuscitation:

“In the back of the truck (ambulance), the supervisor peaks his head in as the ACP (advanced care paramedic) is about to intubate her – I don’t know why, considering there was nothing else done – and was like ‘Why are we doing this? Why aren’t we TOR-ing her?’ (termination of resuscitation). And so then they made the decision to TOR her with no drugs, barely got an IV, like really nothing.” (‘Marcy’)

Or when other responders were perceived to be performing below standard:

“I think I was more angry when I got home. One of the medics wouldn’t switch off CPR, I was pissed with her because it was just annoying, like just do your job! Like no one’s a hero here, just switch off CPR, or at least do something we need like get an IV or something.” (‘Marcy’)

“And then the one extra crew member that wasn’t being overly helpful in the room, I asked him to gather history, meds, allergies and to try and gather more information from the husband...it ended up being a big mistake sending him out to the other room...Because ... I went to the other room to see what information he had gathered ...and I noticed the husband was on the phone with his son and the other crew member took over the phone...Unfortunately his first words to the son were “Well

I'm sorry, I don't know if you've been told, but your mother just passed away this evening." At which point my hands struck my forehead (resuscitation was still ongoing). So I vigorously waved my arms and tried to get him to back peddle on that statement and he looked at me quite confused and didn't understand what he had done" ('Joanna')

"I don't know it was (like) pulling teeth getting the RRU (rapid response unit paramedic) to do what he was told and to stay on point and actually react. ... I felt like I was babysitting. Every once in a while, he was doing something and I was like 'No, I told you to do this' and he was like 'Yeah! But I thought...' and basically giving me the attitude that I'm not doing something that he felt should be getting done." ('Shawn')

In summary, the participants discussed a number of sources of frustration or tension that would manifest during the resuscitations. These arose from confusion over the specific details of the event or disagreement over care – with other responders, but also with family members over desired care plans for patients.

Humanizing Influences

While healthcare providers commonly adopt a professional detachment during care to maintain objectivity, our participants noted the presence of a number of humanizing influences at the scenes, usually as a result of specific artefacts in the environment. In these examples, the participants describe features of the patient's physical appearance that served as reminders that the patients were people, adding a 'human' element to the resuscitation:

'Joanna': "She was wearing nail polish."

JM: "You noticed that..."

'Joanna': "I did, I did notice that. It was remarkable because she was very pale, she was wearing a very light coloured nightgown, there was no jewellery on her, nothing really remarkable, but then she had this color popping (out), these finger nails that were painted, so that really sort of added a little bit more to it and she was a little bit less just...another patient"

'Kacey': "I would say the headphones for me, they were distracting."

JM: "Why were they distracting?"

‘Kacey’: “I don’t know, I still kind of haven’t really come to terms with that, but I think it was more the position of them and where they were, it kind of added another element to it? They were like right beside her (head) in the (pool of) blood. They were white ear-buds. Yeah, and I don’t know if that’s what it was, everything else was bloody and dark and they were just...there. And I don’t know if it was cause I was thinking did she get struck with such force, like were they loose? ... They kind of made you think like she had absolutely no idea what was going on, just totally blindsided...I remember her eyes were open. They were open and I remember noticing because her mascara was smudged.”

In other cases the circumstances of the event, rather than specific features of the patient or environment, appeared to humanize the patient, making the patient relatable as a person to the responders, often leaving them with unanswered questions:

“Certainly I think that anytime I’m dealing with a suicide or a call that involves suicide, you sort of give pause to think ‘what brings a person to this point, where they make this decision’, then the next question, or rather not, the next step is sort of moving on from that – you’ll probably never know” (‘Samantha’)

Still other times, the participants would empathize more with the situation itself in its broader context rather than being specifically focussed on the patient:

“For example, completely different – I don’t know if this is ok – another VSA (vital signs absent) that we did a couple of months ago, it was a 30-year old male, lots of comorbidities (underlying health problems), no shock that he’s VSA at this moment, the call didn’t really, it didn’t ring a bell with me whatsoever until I heard his daughter crying and his daughter’s the same age as my daughter, so that was a lot more real to me than what it would be that someone that doesn’t (have children), or what this call was to me. Because that to me is like, ‘Ok, well that is my worst nightmare that I’m actually in right now’ like I can understand how the wife feels and now their daughter is...” (‘Jamie’)

Often this sense was influenced or prompted by artefacts in the environment. In the following example, a participant describes the moment he noticed pictures of the patient and his family when he went to place some equipment on a dresser beside the patient:

‘Shawn’: “And then there’s a lady (the patient’s wife) who’s going to live there when we leave, so it’s not just like
‘ROOAAARRRGGGGHHHH’ (sweeping hand gesture) with the

pictures, you know, like that's somebody's memories of a person who probably isn't going to come back."

JM: "I hadn't thought about that, did you think about that in the moment?"

'Shawn': "Yeah, I was actually going to throw them off and then I slowly moved them, so there was consideration."

While this 'human connection' didn't appear to influence the care of the patient or the resuscitation directly, these humanizing influences did appear to affect the participants. In this sense, the context – usually physical features present in the environment – created an awareness of the broader implications of the event, allowing the participants to empathize with the patient or others present in the situation.

Personal Ownership or Responsibility

The participants often made statements that suggested they felt a degree of personal ownership over or responsibility for the care of the patient and the management of the resuscitation. These manifest in several ways. For example, the participants would reference having a duty of care to the patient:

"It was one of those ones where 'If we just try harder, we can get this guy back' kind of feeling, you know" ('Shawn')

In other cases, the duty of care to the patient manifested as a desire to preserve the patient's privacy and dignity during the resuscitation:

"I was thinking 'What's this going to look like when somebody opens their door?' (the patient was naked on a stretcher in the hallway of an apartment building) Surprise... But nobody opened their door. The one door we were right in front of, I had a police officer in front of it, I kinda asked him to stand there just in case somebody opened that door and wanted to step out in the middle of us, but nobody opened their door, nobody at all. ... He had a sheet across his mid section, but he was naked." ('Carm')

"Definitely. Without a doubt, because I think patient privacy is very high on the priority list if you're given the opportunity to actually reflect on it" ('Samantha')

"This was the first female VSA (vital signs absent) I've had in a while and so just that, that exposure is very raw for a woman to be exposed to have the (defibrillator) pads put on and so I think um, I mean definitely

to make sure she was covered to go outside, like going outside into a public space to put her onto the stretcher and into the ambulance”
(‘Samantha’)

Other times this duty of care seemed to apply to others in the environment, often the patient’s family. The participants would describe the efforts they made to ensure that death notifications were delivered in a compassionate way, one that provided the family with privacy, support and dignity, noting that when the resuscitation ended, the focus shifted to the bereaved.

“Not knowing who was family, who was privy to information I was giving to the wife, if I’m giving the notification, I wasn’t even able to give her the privacy and dignity of learning the news just with herself and her daughter, there was no other good place to go, and these neighbours were all over the place” (‘Mark’)

“Once all the initial stuff is taken care of, and at that point, usually we know where – which way – the resuscitation is going and that it’s likely a futile resuscitation, um, and so I feel like the next patient is the, the initial patient’s loved one is really now the patient to be concerned about. Not physically, but psychologically, so we need to get that right, they’re now a patient.” (‘Carm’)

The participants also appeared to derive a personal or professional satisfaction from resuscitations that went smoothly – regardless of the outcome – for having provided what they perceived to be high quality care:

“Not necessarily happy, I was satisfied with the job we did, happy is sort of the wrong emotion, but yeah, I’d say like I was satisfied with the care we provided, that it was...complete.” (‘Kristina’)

Conversely, this perceived responsibility to provide high quality care (either to the patient or to others present in the environment) occasionally manifested in uncomfortable ways. One participant shared his experience delivering a death notification and feeling the burden of the task as it approached:

“She (the patient’s wife) knew exactly what was happening and that she was likely going to lose him and it was that utter denial and the bargaining of, you know, ‘You have to do whatever you can’, ‘I’ll do anything!’, ‘I don’t know what I’ll do without him’ and I can see where it would be very easy – and probably attractive – to go down a path of, ‘I’m not going to be the one to make this call’; I will just initiate transport, because it gives the appearance that I’m doing more and I will let someone else deliver the bad news. Then it’s not on me, I’m not the

one who couldn't save him ... Ultimately I knew what the outcome was likely going to be, the science on that has been fairly clear. ... when she had said 'You can't let him die!' and 'He can't go!' and 'I need him!', and to have to say 'I'm sorry I couldn't do more' – and I think I actually said that at one point, you know, I said the usual things and I meant them all – but ultimately, it was 'I'm sorry there wasn't more I could do'. And I don't think there really was any more I could do ... at the end of the day, what I, what I hang on to is she was able to say good bye, she was able to hold his hand and be with him as he died" ('Mark')

The last example from 'Mark' is interesting because it illustrated a situation where the desire for nonmaleficence (i.e., sparing the feelings of the family) conflicted on some level with the duty to provide ethical care (i.e., not continuing a futile resuscitation). Other participants noted this dissonance as well (e.g., 'Shawn' in the section on the emotional state of others), describing situations where the paramedics must weigh the wishes and emotional states of the family with the unavoidable certainty of a patient's death.

In closing, the intersection between the event and the participants appeared to prompt a strong sense of personal ownership and responsibility, sometimes toward the patient, sometimes toward others, but in all cases, out of a deeply held desire to do 'right'.

Importantly, these emotional responses to the event (tension, frustration, empathy and personal ownership) appeared to be directly influenced by the event itself. Physical features present in the environment might complicate care (prompting frustration); others in the environment creates the opportunity for interpersonal conflict (tension); or for humanizing or distracting influences (i.e., promoting a sense of empathy). While the relationship may not be bidirectional – a participant's frustration with a lack of space is unlikely to free up more space in the environment – it is clear that the paramedics react to the event and the circumstances within it.

Theme 4: Simulation Elements

Our final theme describes a number of ideas offered by the participants when asked how we might recreate their specific experiences in a simulated setting and what details would need to be replicated realistically to optimize instruction in cardiac arrest resuscitation.

Recreating Physical Features

The participants made several references to the importance of carefully replicating the physical characteristics of the actual practice environment, noting that for paramedics, the environments are highly variable, often making it difficult to provide optimal care.

“A truly almost over-the-top cluttered environment, where you have the patient in a position where you could probably try CPR but where you know it’s probably not going to be effective and (there’s) nowhere close by to put them down, so you have to make that decision: are we going to start CPR here until we figure out where to move him, even though it won’t be effective?” (‘Carm’)

“Putting a patient in behind a box like you do in scenarios and then the idea is ‘Ok we’ll go and drag him out’ – if they figure that out – like, we’re either going to work this patient behind the box and be really awkward and uncomfortable – which I’ve seen students do which is fun and entertaining – but the solution is to drag them into the giant open area that’s over here and, you’re skipping a thought, you know a step, which is ‘Ok, I don’t want *there*, but where do I want?’ and there’s not always an ideal option, so now you have to think of the best of the worst options, (‘Shawn’)

‘Shawn’: “Maybe putting something really gross on the (patient’s) bed if you’re not willing to (actually) pee on it ... because that was a motivating factor for sure.”

JM: “So it wouldn’t do just to make something wet, it would need to be gross?”

‘Shawn’: “Yeah, wet is fine, everybody would be like ‘Oh we’ll just kneel in it’, it’s a little bit different when it’s some guy’s last ‘Horrrah!’ over his bed. I just want to see you transcribe some of this.”

These physical features of the environment regularly force paramedics to adapt to austere field conditions to optimize care and the participants felt that excluding them in simulations misses an opportunity to develop important cognitive processes. Others commented on the differences between real patients and manikins, noting how physical characteristics of patients can unpredictably complicate certain interventions or procedures.

“The fact that you couldn’t put an airway in, because with most practice scenarios, an airway goes in easily or it didn’t – we tried the King-LT (a supraglottic airway device) and it was literally a gag (reflex) when you put it in, so then we went back to the oral (airway), but then it would like pop up. So at that point, it’s not helping so we just ended up taking it out.” (‘Kristina’)

“When you talk about a patient’s clothing making it more close to real life, like ... just a manikin on the ground with no shirt on, then it’s

pretty straight forward and you do what you need to do immediately without anything hindering you. So that kind of thing, I would think, is not as real. Like if you just go up to a manikin and you say ‘Ok there’s your manikin on this garage floor and it’s got no shirt on’ and you just sort of go start CPR, put the defib pads on or whatever, without having to gain access by cutting his shirt or unzipping or unbuttoning something, then I would think that wouldn’t necessarily be as real” (‘Samantha’)

‘Samantha’: “Like a woman on the ground with her chest exposed and her face blue and a belt nearby versus a plastic manikin that’s two very different things.”

JM: “Most manikins are male...”

‘Samantha’: “Exactly, yeah, or kind of curiously neither here nor there...and a real person moves differently ... you have to secure their limbs before you carry them down the stairs and consider their arms and they’re sort of, I guess you could say floppy. A person’s head flops differently than you know a manikin who’s sort of plastic and stiff.”

The participants also commented on the importance of the acting ability of confederates present in simulations, suggesting that their believability is important to maintaining the perception of realism during scenarios.

“The family members. From my experience with scenarios, it’s almost as if it’s a game on a computer where you click and point on something but when you click on it, something happens automatically.” (‘Jeremy’)

“I think what this particular call highlighted, was the importance of bystander realism. I think that a lot of times when we act as a family member, we act based on our own preconceived notions and biases. My assumption is that a grieving spouse would be distraught, would be crying, would be questioning, would be loud, would not understand. ... But I think that a lot of time we need to take into account those cultural differences and just the way different people respond” (‘Joanna’)

“I mean actors get paid a lot of money because they have a special ability to capture emotions ... in ways that actually trigger those memory cells in our brain that make us empathetic toward it or feel something. It becomes irritating in scenarios when somebody’s supposed to play the (bereaved relative) – it, it belittles and over simplifies what that person is going through (when done poorly) – and therefore what you are experiencing from that (as a learner) and it just

becomes irritating. People just don't sit there and go 'AHHHH!' and, and almost comically getting your way, like it doesn't feel like that in real life – you're just being annoying, I get it, you're a distractor; ok, use a strobe light if you want a distractor or play annoying house music or turn out the lights, or do anything, it's the same thing right? It's just a distractor." ('Shawn')

The participants stressed that faithfully portraying actual practice conditions is important for learning, often arguing that such attention to realism is necessary to replicate the cognitive challenges faced by paramedics and promote emotional engagement.

"It changes things, you're definitely in, you know you're in a 'simulation-mode' and that may change the way you connect with the situation." ('Carm')

"Adding some of the difficulties – realistic difficulties – of having a small space, not: 'No you can't step over on that side of the patient', making the room modular because you can make it smaller or change the configuration. Because in the past I've done scenarios where they're (instructors) like 'Oh well you can't actually walk around that side' Well...yeah, I can. 'No, you can't, just pretend there's a wall there' ('Joanna')

"The patient's airway was difficult to manage for various specific reasons and so that was important to the context. In a simulated setting, somebody would just tell you 'You're going to have difficulty in X Y Z' but the actual difficulty they encountered, the guy's teeth just like fell apart and fell out when they tried (to intubate), ... and so if you're trying to simulate the airway management piece, you'd have to somehow get that right in simulation, I think. Because to just sort of provide verbal feedback 'Oh, you're finding it difficult' ... it's one thing to verbally be told, but it's something else to actually experience it" – ('Samantha')

'Shawn' related a previous experience with a simulation that he perceived to be highly authentic, noting how features of the simulated environment made him believe the experience was real, even though he knew it wasn't.

"You know that (participant mimics monitor beeping), it brought back memories of being in the OR (operating room) and you know all the doctors staring at you, waiting for you to get the tube (successfully intubate the patient) and I'm like 'Wow! This is as terrified as I've ever been in life' and I'm like 'good!' 'Amazing!' and I just felt that all over again listening to the noise (of the monitor), like 'Oh good, the patient's

dying on me, oh wonderful, I should probably get on that airway' so you know that kind of pressure, those noises and stuff, helped, like I, like I felt the need to get in and get involved in those scenarios ... I really thought that the noises and the beeps drew me in to the call even though I knew that it wasn't (real) ... like I wanted to stop those noises from happening." ('Shawn')

In summary, our participants identified a number of ways in which they believed simulations could be strengthened by replicating features that exist in real life. Particularly for paramedics, the physical features of the environment, the other people present, and the characteristics of the patient affect patient care. Remaining faithful to real life when designing simulations was seen to be an important mechanism for developing the skills that paramedics need to successfully care for patients in the field.

Chapter 4: Discussion

Section 1: Summary

The *Merriam-Webster* dictionary defines *context* (noun) as “The interrelated conditions in which something exists or occurs” (Merriam-Webster, 2015). Our research question was intended to explore the ‘interrelated conditions’ in which paramedic practice occurs for a very specific subset of patients. In so doing, we have identified three distinct themes related to context and one related to simulation.

To summarize, our participants articulated rich descriptions of *the event*, including the circumstances leading up to the event, characteristics of the physical environment, the patient and others present. Our participants suggested these properties of context influenced their *conceptual* (e.g., cognitive) and *emotional responses*, suggesting a dynamic relationship between the event itself and the paramedics involved in responding to it. This dynamic process between event and reaction (conceptual and emotional) was emphasized when we asked our participants what features of their clinical experiences would need to be recreated to promote authenticity in a simulated setting (relative to instructional goals); we have broadly categorized these as relating to *simulation considerations*. Our goal in undertaking this research was to develop (or contribute to) a framework that can subsequently be tested in experimental models to investigate the effects of instructional authenticity in simulated environments. In keeping with grounded theory traditions, we purposefully avoided detailed definitions of ‘context’ and ‘fidelity’ during our literature review, choosing instead to remain as open as possible to our participants’ ideas. We now have sufficient data to frame our results within the discourse in medical education research surrounding the terms ‘context’ and fidelity’.

Section 2: ‘Context’

Traditionally, context has been interpreted to refer to either the setting in which the learning occurs or the content of the learning problem or task (Durning, Artino, Pangaro, van der Vleuten, & Schuwirth, 2010). The former flows logically from a behaviorist epistemology in which context – the learning environment – facilitates feedback to promote learning, whereas the latter draws from a cognitivist orientation in which context underpins cognitive processes related to memory (Mann, 2005, 2011). More recent interpretations of context believe it to mean an interactive, often non-linear dimension that includes the physical environment, the persons who populate it and the knowledge and learning that occurs within it (Durning et al., 2010).

For example, situated learning places equal weight on the learners and the environment (or learning community), arguing that learning occurs as a result of the dynamic interactions between the two, ultimately arguing that learning is transformative for both (Kaufman & Mann, 2010). That is, the learner is transformed through participation in a

community and the community is transformed through serving as a medium to promote learning, grooming new members along the way.

Keons et al. have advanced a conceptualization of context that refers to three dimensions: the physical, the semantic and the commitment dimensions. The physical dimension refers to that which can be seen, manipulated and interacted with in the learning environment, including the setting itself. The semantic dimension focuses on the intersection between the knowledge of the learner and the information available in the setting. Finally, the commitment dimension refers to motivational influences within the learners themselves, including emotional engagement (Koens, Mann, Custers, & Ten Cate, 2005).

As a definition, our results parallel well with the framework proposed by Keons et al. The physical characteristics of the environment (space, lighting, temperature), of the patient (appearance, age, sex, defining physical features) describe the physical dimension of context. Similarly, the conceptual response to the event (cognitive challenges and demands) align reasonably well with Keons et al. interpretation of the semantic dimension, in that our participants related their experiences applying knowledge in context. Finally, the emotional response to the event (humanizing influences, sense of ownership/responsibility) is similar to the commitment dimension suggested by Keons et al. Although the authors referred primarily to intrinsic motivation within learners to apply knowledge in educational settings, the themes articulated by our participants would suggest a commitment to engage in the encounter. For example, the participants' comments about having a duty of care to the patient or to others in the environment suggest emotional engagement and a sense of connectedness to the experience.

Our results also contribute somewhat to the recent work by Durning et al. describing context as a complex, non-linear system that evolves over time. The authors argue that the element interactivity between factors within the environment (e.g., physicians, patients, care settings) creates a multiplicative tapestry of potential influences on learning that is difficult to predict or control (Durning et al., 2010). Our results support this notion in that contextual influences appear to be serendipitous, evolving organically with each patient encounter and driven by the physical features of the event, people within it and their interactions.

Understanding how contextual features influence performance – as espoused by our study participants – was an important part of the study to allow us to develop or contribute to a model of context that can be tested in simulation. We acknowledge that in so doing we blur the lines somewhat between the terms context and fidelity; however, we would suggest that understanding the former is important to constructing the latter. We therefore also situate our results within the discourse on fidelity in health professions education research.

Section 3: 'Fidelity'

Traditional interpretations of fidelity within health professions education have tended to focus on the physical characteristics of the simulator and how closely the simulator approximates the genuine article (Ker & Bradley, 2010). Simulators have been classified along a spectrum from low to high fidelity with fidelity, in many cases, being considered synonymous with technological sophistication. Given the growing body of experimental evidence suggesting that the use of higher fidelity (or technology) simulators do not necessarily result in improved learning (i.e., (Chen, Grierson, & Norman, 2015; Curran et al., 2015; Nanji, Baca, & Raemer, 2013; Norman, Dore, & Grierson, 2012), there is an impetus to re-conceptualize our understanding of fidelity (Norman, 2014b; Scerbo & Dawson, 2007).

For example, Hamstra et al. have advanced a framework for classifying simulators according to two criteria believed to be important determinants of learning: physical resemblance and functional task alignment. The former refers to the degree to which the simulator approximates the physical characteristics of the criterion task and the latter the degree to which the task replicates clinical practice conditions in terms of movement, feedback and so on (Hamstra, Brydges, Hatala, Zendejas, & Cook, 2014). The authors recommend abandoning the term fidelity entirely and attending less to the physical appearance of the simulator in favor of cognitive processes and emotional engagement (Hamstra et al., 2014).

Similarly, Grierson has argued that fidelity should be considered within the context of skill acquisition principles, suggesting that deliberate practice, practice variability, feedback and cognitive load are important considerations in the design of simulators (Grierson, 2014). Grierson further argues in favor of de-contextualization of skill performance, noting:

“The information processing perspective demands that we remember that context, by definition, is not a base feature of any skill. While we can appreciate that clinical skills are often performed in chaotic environments replete with stresses and distractions, we must also acknowledge that many of the same skills are regularly carried out under quiet, stress-free conditions” (p. 286)

Our results differ from both frameworks in that the broader context within which performance occurs does appear to matter. In that light, our results appear to parallel well with a slightly older model of fidelity proposed by Dieckmann et al.

Dieckmann et al. (2007) challenged the medical education community to consider simulation as a social process, which they defined as:

“A contextual event in space and time, conducted for one or more purposes, in which people interact in a goal-oriented fashion with each

other, with technical artifacts (the simulator), and with the environment”
(p. 183).

The authors go on to describe a number of theoretical concepts to underpin simulation-based learning as a social process including *modes of reality*, *frames and modulations*, and the *as-if* concept.

Modes of reality refer to three dimensions of reality within which we can consider the fidelity of a simulation. These include the physical mode – what can be seen, measured and manipulated in fundamentally physical terms – the semantic mode – what can be understood through mutual agreement with respect to concepts and knowledge – and the phenomenal mode – which is concerned with the emotions, beliefs and self-aware traits of learners (Dieckmann, Gaba, & Rall, 2007). How these modes of reality (or types of fidelity) are internalized and understood by the learners during a simulation is related to the learner’s primary frames (Dieckmann et al., 2007). Primary frames describe the cognitive structures and processes that people use to make sense of a particular situation. Primary frames can be manipulated through the use of modulations, which include play, rituals and as-if situations to allow for different representations of reality to be accepted given a particular context (Dieckmann et al., 2007).

Using an overly simplified example, consider a group of children playing a game of “Cops and Robbers”. In the game, the children interact with artifacts (toy guns) in a physical setting (a backyard or a playground; the *physical mode*) with the shared understanding that a “robber” “dies” when he is “shot” by a “cop” (*semantic mode*) and the game is fun (*phenomenal mode*) when the semantic ‘rules’ are followed. This occurs because the children approach the game with similar *primary frames* – cops shoot robbers¹ – and a shared *modulation* of the primary frame – robbers pretend to die when cops pretend to shoot them. The ‘success’ of the game depends on the alignment of these theoretical underpinnings.

Using a more professionally relevant example, consider a simulation in which an anesthesia resident is attempting to intubate a crashing trauma patient. The resident interacts with artifacts (the manikin) within a setting (a simulation laboratory; the *physical mode*) with the shared understanding that the “patient” will “die” if the hypoxia is not promptly corrected (the *semantic mode*). The resident shares a common belief with the other participants that the experience is a simulation intended to promote learning (the *phenomenal mode*). The resident approaches the learning task (intubating the patient) with a specific primary frame (how to intubate, what equipment is required and what haptic feedback is anticipated) but the primary frame is modified to account for limitations in the physical mode because the resident engages with the simulation “as if” it is a real event despite the tacit understanding that it is not. The simulation is

¹ In other variations of the game, the “cops” take the “robbers” to “jail” though a tag system but the underlying concept remains the same.

‘successful’ when all of these moving parts (modes of reality, primary frames and modulations) interact smoothly.

Dieckmann et al. argue that limitations in the physical mode can be overcome by increasing semantic and phenomenal fidelity through appropriate modulations of primary frames (Dieckmann et al., 2007). The children *pretend* their toy guns – which may look nothing at all like real guns – work and the game succeeds. Similarly, the resident treats the simulated patient “as if” the patient is real despite physical differences and the simulation succeeds; both of which require an appropriate level of underpinning knowledge and experience and a desire to ‘pretend’.

Our results parallel well with the modes of reality concept proposed by Dieckmann et al. but differ somewhat in the interpretation of how simulations should be structured with respect to fidelity. For example, the descriptions of the physical characteristics of the event conform in large part to the physical mode, the conceptual challenges identified by our participants align well with the semantic mode and the emotional response is similar to the phenomenal mode. Where our results differ is in the belief that appropriately modulated primary frames can enhance semantic and phenomenal fidelity in the face of physical shortcomings. Dieckmann et al. argue:

“Helping participants to accept the as-if character is key to increasing the overall fidelity of the simulation experience. A basic (sometimes mechanistic) assumption is often made that participants will be more likely to accept the as-if character of the simulation merely by increasing the physical fidelity of the simulator and the simulation environment” (p. 189) going on to say “When learning is the focus, the flawless recreation of the real world is less important” (p. 191)

In contrast, our participants highlighted many instances in which conceptual and emotional responses arose primarily as a result of the physical features in the practice environment. For example, the cognitive process to balance the competing clinical and social roles (e.g., attending simultaneously to the resuscitation of the patient and the emotional support of the family) was mentioned repeatedly. This cognitive demand would be entirely absent if the distraught family member was removed from the setting. Similarly, the cognitive processes (and attending frustration) related to working in confined spaces would be removed if the physical characteristics of the environment were more favorable. Finally, the many instances in which our participants were aware of humanizing influences in the environment were driven entirely by physical features of the context (e.g., the patient’s nail polish, pictures of patient with his family, etc.); were these artifacts not present, the emotional commitment of the participants may have been different.

When asked about simulation specifically, our participants articulated several ideas that would suggest difficulty with the ‘as-if’ modulation of primary frames. For example,

participants discussed experiences in which they were told to pretend that the space in the simulation setting was confined when it was clearly not, suggesting a cognitive dissonance that impacts both the phenomenal and semantic modes of reality and the overall effectiveness of the simulation.

Our results would suggest that, for our sample at least, the departure from physical realism emphasized in several conceptualizations of fidelity (Grierson, 2014; Hamstra et al., 2014) might be problematic where physical features of the simulator or the simulation setting influence other elements. Returning to the discourse around context, this suggests that there might be an argument for emphasizing physical realism in simulation to more holistically capture the broader construct of context. Social learning orientations toward learning place equal emphasis on the participants, the learning tasks and the learning environment. This ‘learner *and* environment’ rather than ‘learner *in* environment’ (Durning et al., 2010; Mann, 2011) might be an important consideration for designing simulations. If this is the case, the results of experiments suggesting physical fidelity is non-relevant (Chen et al., 2015; Curran et al., 2015; Nanji et al., 2013; Norman et al., 2012) might arise, in part, from an incomplete understanding of what physical features influence learning and performance; an area for further study.

Section 4: Future Research

As discussed earlier, our intention in undertaking this research was to develop or contribute to a framework for fidelity that could then be used to conduct experiments into the effects of instruction in simulation conditions with varying degrees of authenticity. It is possible that the results from experiments into the effects of fidelity on learning may be influenced in part by an incomplete understanding of what contextual features in clinical practice conditions would need to be replicated in simulation conditions to promote an authentic representation of the criterion task or setting. Having provided some granularity for the out-of-hospital cardiac arrest context, a logical next step would be to study the effects of simulations in which these conditions are recreated along various degrees of realism. Interestingly, this may be most important for non-healthcare professionals.

Out-of-hospital cardiac arrest is a time-sensitive emergency in which those with the potential to do the most good are often not healthcare providers. Bystander CPR has been stressed as an important ‘link’ in the ‘chain of survival’ in cardiac arrest (Kleinman et al., 2015). From a purely technical perspective, the psychomotor characteristics of performing CPR are relatively straight forward, particularly when artificial respirations are removed, as is increasingly being advocated for lay rescuers (Bhanji et al., 2015). Current models of CPR instruction often use very simplistic partial task trainers to teach the technical skill of performing CPR (Bhanji et al., 2015). These manikins provide appropriate haptic feedback and may be useful from a skills acquisition perspective when used according to the principles of deliberate practice. However, de-contextualizing the skill may have the unintended consequence of leaving the lay rescuer poorly equipped to

perform CPR in a real emergency. As we have identified, out-of-hospital cardiac arrests are ‘context-rich’ events with many potential contextual influences on performance. Future studies should therefore consider the benefit of training lay rescuers in more immersive simulations that replicate the physical, cognitive and emotional challenges we have identified to determine whether teaching in a highly contextualized setting promotes improved learning.

Another avenue for inquiry would be to further test the argument that shortcomings in physical fidelity can be compensated for by improvements in semantic or phenomenal fidelity through appropriate modulation of primary frames (Dieckmann et al., 2007). Our participants suggested this concept (articulated by Dieckmann et al. as the ‘as-if’ concept) is problematic in existing paramedic simulation-based learning. Exploring this phenomenon further would provide important theoretical contributions to Dieckmann’s framework for simulation as a social practice and may serve to validate other conceptualizations of fidelity that de-emphasize physical realism.

Section 5: Limitations

We acknowledge some important limitations in our study. First, we drew a clear boundary in the inclusion criteria of the study, delimiting to paramedic participants. Cardiac arrest events are frequently attended by many different individuals including police officers and firefighters as part of a ‘tiered response’ system and bystanders also occasionally intervene in cardiac arrests by performing CPR. The perceptions of these responders on the issue of context are likely important and we acknowledge the shortfall of not triangulating our findings by including their perspectives. Indeed, in recruiting currently practicing paramedics, we selected an experienced group of clinicians. While we attempted to recruit paramedics with varying degrees of clinical experience, it is important to note that the perceptions of contextual influence likely reflect the degree of clinical experience and may be substantially different than what would reasonably be expected from novices. Exploring contextual influences among novice and/or student clinicians remains an opportunity for further study.

Second, we acknowledge the possibility of recall bias among our participants. The passage of time is likely to influence the participants’ memories of the events and the events themselves are likely cognitively demanding. We also acknowledge that not all of our informants held formal positions as educators, calling into question their ability to comment on what contextual influences may be important from an instructional design perspective and perhaps drawing a line between *experience* and *learning*.

Third, when considering the context-dependency effect on recall and transfer, others have commented that the effect may be less pronounced with more complex cognitive processes (application of knowledge rather than recall) and in settings where contextual differences are less pronounced (i.e., classroom to hospital ward versus underwater to on land) (Koens et al., 2005; Norman, 2014a). In selecting out-of-hospital cardiac arrest, we

have chosen a ‘context-rich’ subject of study; it is therefore possible that the influences of context may not be as strongly felt by paramedics in more routine patient encounters.

Finally, it is important to recognize that the constructs ‘fidelity’, ‘authenticity’ and ‘context’ are themselves fluid and often relative to the instructional goals of the particular simulation.

Conclusion

When considering contextual influences on performance in out-of-hospital cardiac arrest, we identified three distinct interrelated themes that can broadly be considered as representative of context: the event, the conceptual response and the emotional response. The relationship between the themes appears to be dynamic, suggesting that conceptual and emotional responses are products of the physical characteristics of clinical practice settings. Our participants also articulated a number of themes surrounding the use of simulation-based learning that illustrate the interrelated nature of physical, conceptual and emotional contextual influences. Our findings contribute to and challenge some of the assertions in theoretical models describing both *context* and *fidelity*. Collectively, we suggest that conceptualizations of either term that de-emphasize the influence of physical features in the learning or practice setting may warrant reexamination in future research.

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Tables

Table 1: Participant Demographic Data

Variable	N	%	Mean	SD
Sex	Female = 9	64%		
Provider Level	PCP = 8	57%		
Teaching Responsibilities	8	57%		
Age			32.4	4.8
Experience			7.6	5.4
Experience at Current Level			5.7	3.8
Cardiac Arrests per Year			10.2	6.9

Figures

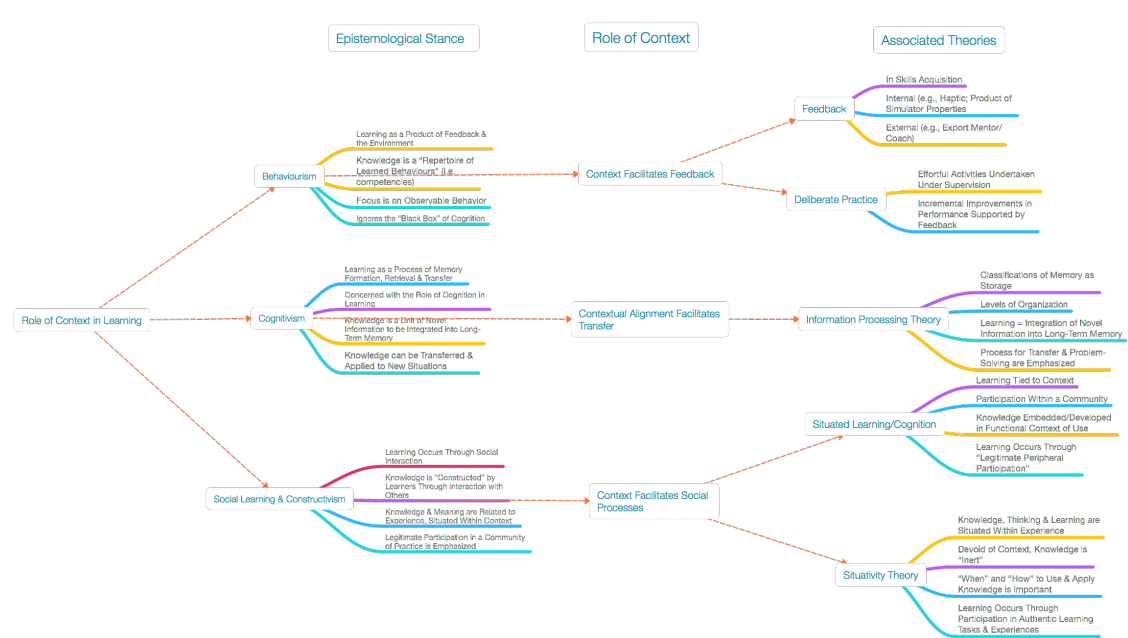


Figure 1: Overview of epistemological orientations toward context and associated theoretical frameworks

Figures

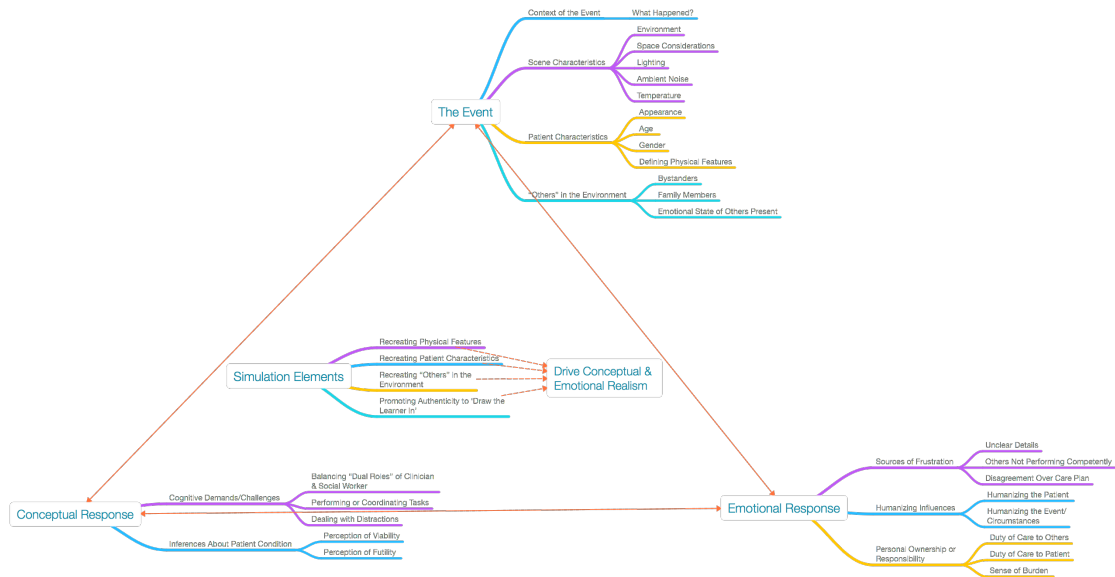


Figure 2: Summary of themes

Appendix 1 – Interview Guide

Preamble

Our goal in undertaking this research is to investigate the effects of instructional authenticity in education. We have reason to believe that using highly authentic (or realistic) teaching strategies (such as simulation) will enhance teaching and prepare students more holistically for clinical practice. We are using sudden out-of-hospital cardiac arrest as an example and we have asked you here today to help us understand what features present in the environment of a cardiac arrest we would need to replicate – and how – to create simulations that are highly authentic.

Semi-structured Interview Guide

1. Tell us about a recent call in which you participated in the resuscitation of a cardiac arrest victim. What was the experience like?
2. If you can, try to picture that scene in your mind. What did the environment (room, layout, people within it, etc.) look like?
3. Is there anything about the experience that stands out in your mind as being particularly important or memorable?
4. What was the emotional tone/climate of the experience like? How did you feel about the experience?²
 - a. Did anything about the experience influence that emotional tone/climate?
5. If we wanted to simulate a sudden, out-of-hospital cardiac arrest, what features of the experience would we need to replicate in order to convince you the experience was real?
6. Thinking about the *cognitive* aspects of a cardiac arrest, what mental challenges or experiences would we need to simulate to convince you the experience was real?
7. Thinking about the *physical* aspects of a cardiac arrest (aesthetic characteristics of the environment, space, layout, people present, etc.) what characteristics of that

² Underlined questions (4, 4a, and 9) were added part way through data collection to further clarify the emerging theme related to humanizing influences in the environment. Questions 4/4a addressed these influences during the event specifically and question 9 emerged as a response to participants suggesting that some elements of the event (related to humanizing influences) might be difficult to recreate.

physical space would we need to simulate to make you believe the experience was real?

8. Thinking about the *emotional* and *social* aspects of a cardiac arrest (your state of mind, the state of mind of others, and the interaction between people at the scene), what characteristics of the experience would we need to simulate to make you believe the experience was real?
9. Are there any reasons you can think of why we might never be able to make a recreation of your experience feel completely real?
10. Do you have any final thoughts on how we might enhance the realism of simulating this kind of experience?

Thank you for participating in this research.

