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# EXPLORATION OF TASKWORK AND TEAMWORK SKILLS OF SELECTED MILITARY PERSONNEL

by

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## Dedication

*To my wife, Stacey; without her patient support, I would not have dared to dream so big.*

*For the U.S. Army combat soldier, past, present, and future.*

**Acknowledgments**

I want to acknowledge my committee, Dr. Bagwell, Dr. Johnston, and Dr. Mensah. Drs. Bagwell and Mensah provided both encouragement and constructive criticism. Their efforts have substantively improved my scholarship. Dr. Johnston earns specific acknowledgment for taking considerable personal time to mentor me over the last four years; I sincerely appreciate her guidance and wisdom. I would also like to acknowledge First Sergeants Randall Bethea and John Phillips who served as the Army subject matter experts on this research effort. Without their tactical expertise and unwavering support, this study would not have been possible.

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## Abstract

Army soldiers need teamwork skills to form agile and adaptive teams, but these skills are not systematically addressed during training. A lack of teamwork skill development results in suboptimal performance of combat soldiers. The researcher explores the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States using a single-case, embedded design approach on a 2016 database. This qualitative study employs pattern matching methods to enumerate behavioral markers at the squad level and quantitative methods to examine embedded subunits of Army teams (Yin, 2018). The conceptual framework used during this study is based on a recent meta-analysis linking team cohesion, collective efficacy, and communication to team performance (Sottilare et al., 2017). The researcher examined the database to identify the patterns of taskwork performance and teamwork skills that are reflective of team cohesion and collective efficacy. Sixty-four soldiers composing 21 teams formed the basis for pattern matching analysis. This study concludes that patterns of teamwork skills that are reflective of team cohesion and collective efficacy can be measured during training situations with behavioral markers. Findings indicate that team cohesion and collective efficacy are antecedents of performance in Army combat teams. Additionally, teamwork skills intervention improves the performance of Army teams from both conventional and special operations units. Including teamwork skills in debriefs allows soldiers to optimize training and improve their combat readiness. Future research should quantitatively confirm these findings with a larger sample size and should explore the relationship of trust among soldiers in Army squads.

# Chapter 1: Introduction

The U.S. Army is well adapted to face a single adversary in a linear environment over known terrain (Matthews, 2013; Scales, 2016). However, current threats to U.S. forces vary in nature, including state and non-state actors, terrorist groups, and hybrid threats (U.S. Department of the Army, 2014). Each of these threats possesses a different set of capabilities both qualitatively (e.g., unmanned aircraft and cyber warfare) and quantitatively (e.g., multiple independent terrorist cells, single large-state actors; U.S. Department of the Army, 2017b). The ongoing low-intensity conflict in Iraq and Afghanistan over the last 17 years has decreased the U.S. Army's capacity to respond to these new threats (Scales, 2016). The intricate nature of the current operational environment and the speed at which situations change at the tactical level necessitate a force that is agile and adaptive (U.S. Department of the Army, 2014, 2017b, 2017c).

The U.S. Army squad is the foundation of the fighting force; it comprises two four-person teams and a squad leader (U.S. Department of the Army, 2014; Scales, 2016). Teams and the squads they compose are the basis for the tasks, organization, and structure of larger units and commands (Mundweil, 2013). The organizational hierarchy makes teams, teamwork, and team performance crucial to the U.S. Army. Soldiers are primarily organized into teams for efficiency of control, but as tasks increase in complexity, teamwork becomes more necessary because a single soldier may not have all of the information, training, or skills to accomplish the task (DeChurch & Mesmer-Magnus, 2010). Complex tasks in varied environments require effective teamwork (Goodwin, Blacksmith, & Coats, 2018). The question of team efficacy and team cohesion, of how well squads and the teams within them work together, has grown increasingly important to the U.S. Army and its mission (U.S. Department of the Army, 2017b).

As mentioned previously, the modern battlefield is increasingly complex (U.S. Department of the Army, 2017b). To be ready for rapidly changing conditions, soldiers in Army teams need to be agile and adaptive (U.S. Department of the Army, 2017c). Agile soldiers and Army teams are capable of changing tactics as the battlefield evolves, a critical factor of soldier-team performance in complex environments (U.S. Department of the Army, 2017d). Taskwork elements of soldier and soldier-team agility are routine in Army training; clearly defined measures, such as task-condition standards and evaluation outlines, assess soldier-team performance and track progress, with debriefs to reinforce training (U.S. Department of the Army, 2008a). However, technical taskwork only accounts for part of soldier-team performance (Cooke et al., 2003; Kozlowski, 2006; Salas, Cooke, & Rosen, 2008; Salas, Vessey, & Landon, 2017). Another crucial aspect of team performance is teamwork, but systematically assessing teamwork skills in field environments has proven challenging; furthermore, these skills are not addressed in team debriefs. This research explores patterns of teamwork skills as emergent phenomena that should be captured dynamically as they occur in training (Kozlowski, 2015; Kozlowski & Chao, 2018).

The purpose of this qualitative case study was to explore teamwork skills of selected combat soldiers in training situations in the Southeastern United States. This study aims to inform the practice of field research, address gaps in the current literature, and influence Army decision makers in regard to combat soldiers. The objective of this research is to identify patterns of teamwork skills and team performance through observable communication behaviors. This chapter provides background and context for the issue, the central problem and purpose, followed by an overview of the conceptual framework and methodology. The chapter then outlines the study's research questions, assumptions, delimitations, and limitations, which guide and bound the study. The chapter concludes with the significance of the study, definitions of terms, a brief organization of the entire study, and a chapter summary.

**Background and Contextualization of the Issue**

Modern combat is characterized by teams of soldiers working in a complex, dangerous, and austere environment. The literature (Bartone, Krueger, & Bartone, 2018; Corneliussen, Leon, Kjærgaard, Fink, & Venables, 2017; Kjærgaard, Leon, & Fink, 2015; Salas, Vessey, et al., 2017) described this teamwork environment as isolated, confined, and extreme (ICE). In the Army context, the term "isolated" is characterized either by soldiers on a combat tour, such as for combat operations in Afghanistan, Syria, or Iraq, or by soldiers on an extended training deployment who are separated from their families, friends, and social networks; in isolated environments, there is no practical distinction between professional and personal life (Salas, Vessey, et al., 2017). "Confined" refers to inadequate personal space and limited privacy (Kearney, 2016); deployed soldiers often live in tight, shared quarters or open bays to minimize the logistical footprint needed for support (i.e., resources). "Extreme" refers to an environment in which the team is frequently exposed to potentially realistic, imminent physical harm (Kjærgaard et al., 2015; Salas, Vessey, et al., 2017). Few examples are more representative of the extreme environment than a soldier in combat: for professional soldiers, training missions present the potential for serious injury or death. Operating in ICE environments are thus especially challenging for teams, so in these environments, team performance is particularly critical, often with life-or-death outcomes (Corneliussen et al., 2017; Kjærgaard et al., 2015).

Team performance is critical to the tactical and strategic objectives of the U.S. Army. Threats to U.S. forces are varied in nature, and each threat has a different set of capabilities, strengths, and vulnerabilities (Scales, 2016; U.S. Department of the Army, 2014). In addition to the increasing complexity of modern warfare, another emerging challenge is that tactical decisions are being made at lower echelons than in previous wars (Scales, 2016). This issue is twofold. First, to be responsive to changing conditions on the battlefield, junior soldiers are responsible for making higher-level tactical decisions than they made in previous conflicts (Scales, 2016; U.S. Department of the Army, 2017d); both during training and in combat, they are expected to make fast, accurate decisions without having to pass all tactical decisions through their higher command (U.S. Department of the Army, 2017d). Second, the setting in which they operate, whether combat or humanitarian effort, often requires soldiers to consider a variety of disparate information sources, including tactical and strategic as well as cultural inputs (U.S. Department of the Army, 2014).

Army teams perform complex taskwork in austere environments. Often, team taskwork requires sharing knowledge and information among team members (Cannon-Bowers & Salas, 2001). In these situations, mission success may depend on coordination among all team members who need access to combined information (Cannon-Bowers & Salas, 2001). Ensuring that information is diffused throughout the team is critical to mission success. Austere environments, such as space and combat, create challenges to effective communication, thereby making otherwise simple taskwork activities more complex (Salas, Vessey, et al., 2017).

Over the past five years, the U.S. Army has increasingly emphasized agility and adaptability to better enable squads to react to the changing conditions of the battlefield (U.S. Department of the Army, 2014, 2017b; U.S. Department of Defense, 2012). Agile and adaptive soldiers should have the ability to think through complex situations and to consider a variety of inputs that might impact the mission (U.S. Department of the Army, 2017d). These complex situations pertain to strategic goals as well as local tactical initiatives. The battlespace U.S.

soldiers occupy is becoming increasingly complex, and the current speed at which warfare grows more sophisticated may be unparalleled in history (Matthews, 2013). In the face of this growing complexity, close combat at the squad level is critical to achieving tactical success and strategic objectives, so the issue of team performance has grown increasingly salient (Scales, 2016).

Agile and adaptive soldiers are most critical at the level of the smallest operational unit: the squad. The Army's maneuver force, often seen as an immense unit, is actually composed of these relatively small elements, which is considered the foundational fighting force of the U.S. Army (Goodwin et al., 2018). A typical Army squad comprises nine soldiers: two teams of four soldiers each, plus a squad leader. Each of the two teams has an automatic rifleman with a weapon capable of automatic fire, a grenadier with a 40-mm grenade launcher attached to the primary weapon, a rifleman, who carries a standard issue M4 or M16 series semiautomatic rifle, and a team leader (Mundweil, 2013). An Army squad is the base unit at the tactical edge of every engagement (Scales, 2016); it is augmented as needed by enablers (e.g., engineers, civil affairs, psyops, or intelligence) to provide tailored capability to the mission set. This complexity in the current operating environment mandates that to accomplish their missions, squads must be more agile and adaptive than ever before (Scales, 2016; U.S. Department of the Army, 2017c).

The current need for agile and adaptive soldiers is extraordinarily high at the squad level and places extraordinary demands on the soldiers with the least experience (i.e., those at the rank of private through specialist; Mundweil, 2013). The greater ambiguity of combat situations requires soldiers to develop and master an increasingly advanced set of skills in order to perform their tasks and assignments and achieve mission success. The U.S. Army Training and Doctrine Command 525-3-7-01 summarized these demands as follows:

> The future operational environment will continue to demand competence on complex cognitive tasks from younger, less experienced officers and NCOs. Yet, research on human performance has shown that an individual typically needs about 10 years to master a complex set of skills. This does not suggest that soldiers of all ranks require ten years to become proficient in their specialties, but rather acknowledges that mastery and complexity will take longer if the Army does not find ways to accelerate the learning process. (U.S. Department of the Army, 2008b, p. 115)

Research on team performance in extreme environments has identified team cohesion and adaptation as critical factors (Baard, Rench, & Kozlowski, 2014; Bell, Fisher, Brown, & Mann, 2016; Driskell, Salas, & Driskell, 2017; Kozlowski, 2006). High-functioning teams in ICE environments develop a shared mental model. Mohammed and Hamilton (2010) defined team mental models as "organized mental representations of the key elements within a team's relevant environment that are shared across team members" (p. 877). This model is created by environmental factors that promote strong social cohesive bonds among team members in ICE environments (Bartone et al., 2018; Corneliussen et al., 2017).

The research literature indicates that teams are not limited to a single mental model. Rather, multiple models can be shared within the team or overlap among team members. For example, teams may have different shared mental models predicated for taskwork, teamwork, and technical work (Cannon-Bowers, 2000). Team cohesion is highly correlated with team performance. A meta-analysis examining effective teamwork collated data from team research studies ($N = 3{,}738$) and found that along with two other significant contributors, team cohesion explained a significant amount of the variation (18.4%) in team performance (DeChurch & Mesmer-Magnus, 2010).

**What is known about the topic.** Teams and teamwork have been studied by the military for many decades (Cooke, Salas, Kiekel, & Bell, 2004; Goodwin et al., 2018) and have more recently been the focus of study in both industry and academia (DeChurch & Mesmer-Magnus, 2010; Il-Hyun, 2012; Marriage & Kinnear, 2016). Teams are better able to handle complex tasks and solve challenging problems than individuals (Salas et al., 2008). There are robust theories and numerous empirical studies on teams, teamwork, and team performance in different contexts. This subsection describes the characteristics of team performance, provides an overview of team debriefs, discusses the elements and measures of team cohesion, and introduces emerging research in the field.

For decades, industrial and organization psychologists and theorists of training and education have focused on understanding the drivers of team performance, of which mental models have been shown to be extremely powerful (Cannon-Bowers, 2000; Cannon-Bowers & Salas, 2001; Mohammed & Hamilton, 2010). Rather than the simple accumulation and sharing of individual models, shared mental models among soldiers reflect the convergence of multiple visions into a single, shared knowledge pool for the team. Since team performance depends on a shared vision and group objective, shared mental models are a primary driver of collective efficacy (Cannon-Bowers, 2000; Salas, Vessey, et al., 2017).

Team communication, defined as “an exchange of information, occurring through both verbal and nonverbal (e.g., email) channels, between two or more team members” (Marlow, Lacerenza, Paoletti, Burke, & Salas, 2018, p. 146), is a crucial factor in developing mental models and improving team performance. Communication drives much of team performance because it is the precursor to knowledge sharing and information elaboration. Complex tasks that require effective teamwork depend upon individual team members sharing the collective knowledge of the broader team (Fernandez et al., 2017; Grand, Braun, Kuljanin, Kozlowski, & Chao, 2016).

Measuring team communication is important for meaningful team assessment (Kjærgaard et al., 2015; Urban, Bowers, Monday, & Morgan, 1995). Measures of team communication include frequency (i.e., the number of interactions between members), degree of clarity (i.e., whether the communication was received as intended), and the extent of knowledge transmitted (Marlow et al., 2018). As teams work in concert to achieve positive outcomes, communication is crucial to many of their processes. These processes vary by task, but in general, team communication can clarify directions and instructions among team members as well as distribute important information about, for instance, task-based, environmental changes (Marlow et al., 2018).

Though both the quality and frequency of communication impact team performance, quality has a greater impact on performance as compared to frequency (Marlow et al., 2018; Urban et al., 1995). Communication frequency adds value up to a point, but too much communication can introduce potentially irrelevant information (i.e., noise) into the system. High-quality communication is characterized by providing the information necessary for task completion while minimizing additional noise (Marlow et al., 2018; Urban et al., 1995). Because the process-based teamwork attributes of team cohesion and team efficacy are mostly exchanged through verbal and nonverbal communications in a squad, they are challenging to observe, record, and assess (Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013; Kozlowski, Chao, Grand, Braun, & Kuljanin, 2016; Salas, Vessey, et al., 2017).

Decades of studies show that team debriefs, referred to as After Action Reviews (AARs), are an inexpensive, unobtrusive, and effective approach to reliably improving team communications and performance (Reitz & Seavey, 2016; Ron, Lipshitz, & Popper, 2006; Tannenbaum & Cerasoli, 2013). A meta-analysis on team debriefs by Tannenbaum and Cerasoli (2013) found that "organizations can improve individual and team performance by approximately 20% to 25% by using properly conducted debriefs" (p. 1). This quantitative study included published and unpublished literature on team debriefs, culminating in an indication ($N$ = 2,136) that effective debriefs increase team efficacy over a control group ($d$ = .67; Tannenbaum & Cerasoli, 2013).

Team AARs were developed by the Army in the 1970s (Laurence & Matthews, 2012) and later adapted to industry (Bolton, 2016; Hotvet, 2016; Sawyer & Deering, 2013). A required component of standard Army training, team AARs are conducted after each training exercise or live mission. According to Army Regulation 350-6:

> An AAR is a professional discussion of an event, focused on performance standards, which enables Trainee/Soldiers to discover for themselves what happened, why it happened, and how to sustain strengths and improve on deficiencies. It is a tool leader and units can use to get maximum benefit from every mission or task. (U.S. Department of the Army, 2017a, p. 92)

However, these standard performance reviews are focused on procedural taskwork skills. Procedural work is epitomized by the standard Army performance measurement called "task-condition-standard." For example, infantrymen are expected to maintain their primary weapon, an M4 series carbine (task); soldiers are expected to correctly clear, disassemble, assemble, and perform a functions check (condition); within two minutes, the soldier must complete these actions in sequence (standard; U.S. Department of the Army, 2008a). However, the procedural taskwork skills assessed in this task-condition-standard model differ from process-based teamwork skills. Many of the combat duties and complex cognition responsibilities soldiers carry out in the field do not necessarily fit in the task-condition-standard model (Bickley et al., 2010). Thus, team cohesion and team efficacy, the essential elements of teamwork, are neither formally measured nor assessed during most Army squad training.

Process-based teamwork attributes are important drivers of team performance, but they are more difficult to capture and assess (Kozlowski et al., 2016; Salas, Vessey, et al., 2017). The majority of teamwork research relies on static methods of collecting attributes in the field, such as self-reports and Likert scales (Salas, Vessey, et al., 2017). Self-reports are common in both industry and academia largely because they are easy to use, inexpensive to develop, and relatively unobtrusive (Herzog & Bowman, 2011; Salas, Vessey, et al., 2017). However, self-reports have limitations in effectiveness. Prince et al. (2008) found that "correlations between self-report and direct measures were generally low-to-moderate and ranged from -0.71 to 0.96" (p. 1). Other self-report research found participants are more likely to modify their responses based on fear of reprisal or social desirability; additionally, self-report measures are subject to judgment errors (Donaldson & Grant-Vallone, 2002; Salas, Vessey, et al., 2017; Sottilare et al., 2017). In recent literature, though, the development of behavioral markers of team performance demonstrates a potential to improve measuring emergent characteristics of team performance (Kozlowski, 2015; Wiese, Shuffler, & Salas, 2015). Behavioral markers are observable, quantifiable measures that offer objective measurement, and as supplements to subjective feedback and self-reports, can provide a check to the errors inherent in subjective measures. Supplementing or replacing self-reports with behavioral markers could reduce the potential of error in the collection method (Sottilare et al., 2017).

**What is not known about the topic.** Teamwork skills have been recognized as a crucial aspect of team performance. However, systematically assessing those skills in the field environment has proven to be challenging. Current field research uses static measures of team performance, such as Likert scales and self-reports, but static assessment measures of team performance create a mismatch in field research because team performance is a dynamic, emergent phenomenon (Kozlowski, 1998, 2006; Kozlowski & Chao, 2018). Dynamic team performance models are useful, but they lack corresponding measures of teamwork skills and behaviors for practitioners (Kozlowski et al., 2013). Improved measures of team performance are needed to understand the full impact of training interventions (Salas, Vessey, et al., 2017).

Field studies are rare but critical to understanding team performance in practical settings. These studies are particularly useful to educational and organizational research because they produce the most realistic actionable tools for use in real-world applications (Eden, 2017). Field studies can advance understanding of both team development and team evaluation. Although researchers (e.g., Eden, 2017) have recognized randomized laboratory experiments as valuable methodological constructs because of their high internal validity, field studies go beyond the laboratory, adding value to research through their high external validity. This combination of internal and external validity makes field studies particularly valuable to researchers who aim to inform practitioners (Eden, 2017).

**What this study sought to discover.** This research study explores patterns of teamwork skills and team performance within the context of Army combat squads; it explores patterns of teamwork skills as they emerge in training (Kozlowski, 2015; Kozlowski & Chao, 2018) and examines how they affect team performance in selected Army units. By utilizing a single-case embedded unit method on an existing dataset from a recent field study of U.S. Army teams, this study explores current research insights and conceptual models to determine the efficacy of transitioning findings into the field for practice. Using field research as the basis for this study improves the understanding of team dynamics and contributes to the advancement of improved behavioral markers. Additionally, this study evaluates teams who were provided training in teamwork skills and compares their performance to teams who were not provided teamwork skills training; this comparison will help to more completely understand the drivers and antecedents of team performance in dynamic environments.

**Problem Statement**

The modern battlefield is increasingly complex, and to effectively adapt to evolving conditions on the battlefield, soldiers in Army teams need to be agile and adaptive (U.S. Department of the Army, 2014, 2017a, 2017b). Taskwork elements consisting of clearly defined measures of soldier performance are routine in Army training, as are debriefs that reinforce learning. The taskwork debriefs take place at the team level, making them effective training mechanisms (Goodwin et al., 2018). However, to create adaptive and cohesive teams, soldiers need both taskwork and teamwork skills (Salas, Vessey, et al., 2017; U.S. Department of the Army, 2017d).

Technical taskwork accounts for one part of soldier-team performance (Cooke et al., 2003; Kozlowski, 2006; Salas et al., 2008; Salas, Vessey, et al., 2017). However, squad members employ both taskwork skills and teamwork skills to achieve the mission. While taskwork skills are addressed in team debriefs, teamwork skills are not. Teamwork skills are a crucial aspect of team performance; they have been used to explain “18.4% of the variance in team performance” (DeChurch & Mesmer-Magnus, 2010, p. 41), but team debriefs do not currently include evaluation of teamwork skills.

Teamwork is an emergent phenomenon that needs dynamic measures to capture performance metrics effectively (Grand et al., 2016; Kozlowski & Chao, 2012, 2018). The U.S. Army has robust and well-established assessments for measuring taskwork but currently uses only static measures to assess teamwork (U.S. Department of the Army, 2017a). Static self-report measures provide only snapshots of teamwork skills and are only captured before or after an event, not during the event (Cooke et al., 2004; Salas & Fiore, 2004); also, self-report measures are prone to biases (Donaldson & Grant-Vallone, 2002). Due to their static nature and potential for bias, self-report measures are not well-adapted to capture dynamic, emergent phenomena (Kozlowski, 2015). Dynamic measures of teamwork are available in the literature, but they have not yet been utilized to assess soldier teamwork in field environments (Kozlowski, 2015; Sottilare et al., 2017). The teamwork skills U.S. Army soldiers need to form agile and adaptive teams are not addressed during the team debriefs used to reinforce learning. Additionally, because they are static, current teamwork measures are maladapted to capture teamwork skills as they emerge in field environments (Kozlowski et al., 2013, 2016).

## Purpose Statement

The purpose of this qualitative case study was to explore teamwork skills of selected combat soldiers in training situations in the Southeastern United States.

## Overview of Conceptual Framework and Methodology

The conceptual framework used during this study is based on a recent meta-analysis from the journal article titled “Designing Adaptive Instruction for Teams: A Meta-Analysis” (Sottilare et al., 2017) and is appropriate for qualitatively exploring patterns of teamwork skills and team performance in the U.S. Army. Team cohesion and collective efficacy are team attitudes that research has shown to be antecedents of team performance (Sottilare et al., 2017). However, attitudes cannot be effectively and unobtrusively measured in field environments because it is not practical to cease a training exercise to administer Likert scale self-reports. Therefore, team communications, measured through behavioral markers, provide an unobtrusive mechanism that can explore the precursors to team performance in real-time (Sottilare et al., 2017). Figure 1 depicts the conceptual model that serves as the foundation for this study.

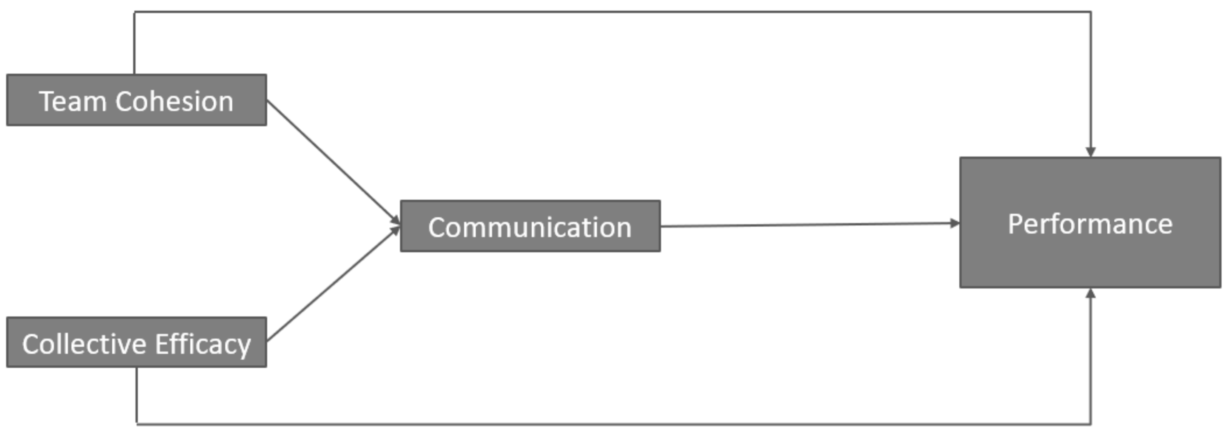


*Figure 1.* Conceptual model diagram. Adapted from Designing adaptive instruction for teams: A meta-analysis. *International Journal of Artificial Intelligence in Education, 28*(2), by Sottilare et al. (2017), p. 236. Copyright 2017 by the International Artificial Intelligence in Education Society.

**Development and refinement of the conceptual framework.** Starting in the mid-1950's, researchers exploring teams and teamwork assumed that because teams are composed of individuals, optimizing training outcomes and educational techniques for the individual would maximize the training effectiveness of the team (Salas, Kozlowski, & Chen, 2017). This assumption is incorrect (DeChurch & Mesmer-Magnus, 2010). Research examining the performance of highly effective teams suggests that teams who perform well share a common mental model (Gardner, Scott, & Abdelfattah, 2017; Kozlowski & Chao, 2018) and that the most effective teams do not always comprise the highest-performing individuals (Cannon-Bowers, Salas, Tannenbaum, & Mathieu, 1995; Salas, Kozlowski, et al., 2017).

The notion of team cognition, team attitudes, and their effect on performance has been prominent in psychology research since the 1990s (Salas, Kozlowski, et al., 2017). In 2017, Sottilare et al. (2017) combined numerous individual concepts related to team performance and proposed an ontological framework based on results from their meta-analytic structural model. Initial elements of the model originated from research regarding training considerations for adaptive teams and making tactical decisions under stressful conditions (Johnston, Poirer, & Smith-Jentsch, 1998; Kozlowski, 1998; Paris, Johnston, & Reeves, 2000). Kozlowski and colleagues continued their research and integrated elements of team cohesion and workgroup effectiveness (Kozlowski & Chao, 2012; Kozlowski & Ilgen, 2006). Subsequent research incorporated more field training studies, behavioral markers, and team cognition (Kozlowski et al., 2013; Spiker & Johnston, 2013; Wildman, Salas, & Scott, 2014).

The conceptual model for studying teamwork can likely attribute some of its origin to early theoretical work in information processing theory (IPT). The IPT is a broad collection of different learning theories that postulates that human learning is the collective accumulation of knowledge through encoding new information (Thomas, 2005). The IPT suggests that human cognition and memory work like a computer, encoding new information for retrieval during later events. Conceptions of knowledge and cognition based on IPT share an emphasis on certain key features of cognition, such as the ability to receive input and to process, store, and retrieve useful information (Thomas, 2005). Due to the team communication elements of the conceptual model, Sottilare et al. (2017) built on, revised, and adapted elements of IPT to accommodate the characteristics of team sharing that contribute to team performance.

Sottilare et al. (2017) built on his earlier work, which was focused on improving student learning outcomes (Sottilare & Proctor, 2012). The core issue the authors sought to address was whether or how advances in artificial intelligence could develop intelligent computer tutoring systems. Early work from Bloom (1984) and others (e.g., Kulik & Fletcher, 2016; VanLehn, 2011) have long advocated the benefits of improved student-to-instructor ratios. Intelligent tutoring systems seek to reap the benefits of improved ratios at a reduced cost. Refinement of the conceptual model put forth by Sottilare et al. (2017) was built upon their early work on intelligent tutoring, which used behavioral markers to identify the antecedents of student learning outcomes (Sottilare & Proctor, 2012).

**Conceptual framework concepts.** The conceptual framework put forward by Sottilare et al. (2017) includes six concepts that influence performance: collective efficacy, team cohesion, trust, communication, coordination, and leadership. A seventh concept, conflict, is characterized as a behavior which reflects the opposite of positive teamwork. While their conceptual framework depicts six positive concepts, the authors highlight three concepts as particularly salient: collective efficacy, team cohesion, and communication (Sottilare et al., 2017). The highlighting of these three antecedents of team performance justifies focusing on these concepts for this study.

The concepts in Sottilare et al. (2017) inform the conceptual framework that guided this study. The conceptual framework for this study outlines two primary concepts: team cohesion and collective efficacy. Team cohesion and collective efficacy serve as both predictors of and antecedents to team performance (Kozlowski & Chao, 2012; Salas, Estrada, & Vessey, 2015; Sottilare et al., 2017). As attitudes that facilitate teamwork skills, team cohesion and collective efficacy predict team performance and thus are also antecedents to team performance and learning (Sottilare et al., 2017). The conceptual model was derived from a meta-analysis designed to enumerate the attitudes and behaviors that precede performance and learning outcomes.

Communication is an important teamwork skill. The interaction of team members communicating information is the key process by which knowledge is transmitted in teams. Communication is composed of three elements worth noting. The first is member selection, which is essentially the likelihood that an individual independently expects to communicate (Grand et al., 2016). Member selection is especially important in teams with task-based objectives like U.S. Army squads, because *who* decides to speak and *why* they made that decision are both critical inputs (Grand et al., 2016). The second element worth noting is retrieval, the mental process of determining relevant information and preparing it to be shared with the team. The third element worth noting is sharing, or the communication between team members, because it effectuates the actual transmission of information (Grand et al., 2016; Sottilare et al., 2017). As a supplemental teamwork process, sharing is central to this study, because it lays the foundation for higher-level emergent constructs (Grand et al., 2016; Kozlowski et al., 2013). Sharing is an objectively measurable activity that can be used both to quantify and qualify a team's communication skills and to determine how those skills affect team performance (Sottilare et al., 2017).

Recent theories in team cognition support the connection between communication and performance. For example, Grand et al. (2016) showed that individuals and teams can either internalize or externalize information. The mechanism by which information is internalized or externalized is not a discrete outcome but rather one that lies on a continuum. For instance, information can be internalized by an individual or by an individual and the team; it can also be internalized somewhere between these two points on the spectrum (Grand et al., 2016).

Similarly, information can be externalized by an individual or by an individual and the team, or it can be externalized somewhere between these two points. The summation of all externalized and internalized knowledge for the combined individual and the team is collectively known as the knowledge pool (Grand et al., 2016).

**How the conceptual framework supports the study.** The conceptual model provided a framework within which to explore the communication patterns of teamwork skills and the resulting soldier-team performance; it thus provided a bridge between the conceptual and the practical. The data that the Army Research Lab (ARL) provided in support of this study included the fully-instrumented site video and audio files of team-based communications from the Squad Overmatch (SOvM) study. Moreover, there is an urgent need for research of this kind (U.S. Department of the Army, 2017b; Townsend et al., 2018). As a group, Army commanders are outcome-driven, focused on performance and completion of their missions (U.S. Department of the Army, 2015b). By evaluating team communication as a driver of squad and team performance, this study can potentially produce findings relevant to U.S. Army decision-makers.

The Sottilare et al. (2017) framework provided the conceptual basis to explore behavioral markers in their capacity as objective communication measures within the context of team performance. This framework served as a roadmap to utilize behavioral markers in order to identify patterns of teamwork skills. Other recent research studies supported the use of communication and teamwork skills as drivers of team performance. For example, Grand et al. (2016) demonstrated that the rate of communications is an important driver in overall team performance. One of the most relevant implications of the theory of knowledge emergence (TKE) is "which and how often [team] members share information is as—if not more—critical to the development of team knowledge emergence than what information gets shared" (Grand et al., 2016, p. 1377). While the rate of communication may seem intuitively linked to team performance, it had not been previously demonstrated.

The conceptual framework utilized for this study is relatively recent (i.e., 2017). This researcher has explored recent publications but is unaware of any that utilized this particular conceptual framework. However, other research studies have made the connection between cohesion, efficacy, and performance in teams. For instance, Paul, Drake, and Liang (2016) utilized a similar model consisting of effectiveness, trust, cohesion, and performance to explore relationships in subgroups of global virtual teams. Similarly, Hedlund (2017) utilized trust (i.e., psychological safety), collective efficacy, team cohesion, and team learning as constructs of a model that predicts performance outcomes in a military context.

**Why this conceptual framework is appropriate.** Examination of the development, accumulation, and expression of teamwork skills lacks robust, dynamic measures and assessments (Salas, Vessey, et al., 2017). The collaborative nature of teams and the variety of methods for sharing information make team cognition, attitudes, and skills particularly complex and difficult to measure (Kozlowski, 2006; Kozlowski et al., 2016; Salas, Vessey, et al., 2017). In part, the difficultly associated with measurement is why previous research has largely consisted of static snapshots. Recent research has shown promise and is advancing empirical support for team cognition (Kozlowski, 2015; Kozlowski & Chao, 2012). Psychologists have put forth psychometric measures to quantify how individuals communicate within a team setting. Grand et al. (2016) pushed the science of team cognition forward by developing TKE, which accounts both empirically and dynamically for team interactions, and Sottilare et al. (2017) empirically mapped team attitudes and teamwork skills to team learning and performance.

This conceptual framework is best suited for this study primarily because it makes the connection between team communication, learning, and performance. The Sottilare et al. (2017) framework was particularly appropriate because it provides the conceptual basis to use behavioral markers to explore teamwork skills and teamwork performance in dynamic environments. Other team performance frameworks focus on team attitudes as a static rather than dynamic phenomenon. For example, DeChurch and Mesmer-Magnus (2010) studied a single aspect of teamwork through a post hoc analysis of one event. While this study was necessary to examine the phenomenon further, it provided little insight into how to explore teamwork skills as they emerge rather than as they exist in static increments.

**Methodology.** The researcher used a qualitative methodological approach for this study. Specifically, a single-case, embedded design was used to explore the research questions and topic. Case studies require a thorough analysis of an event over a designated time period (i.e., SOvM database); therefore, this method was appropriate for this study given the topic and questions (Yin, 2018). Case studies are most applicable when it is impracticable to separate the elements of observation from their context, in this case, team cohesion and team efficacy from Army combat training. Embedded designs facilitate data collection at the subunit level, in this case, Army teams, which in turn helps to explain the phenomenon at higher echelons, the Army squads (Yin, 2018).

## Research Questions

The following overarching research question guided the study: What are the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States? The following topic related research sub-questions were developed from the problem:

**RQ1:** What are the patterns of teamwork skills that are reflective of team cohesion?

**RQ2:** What are the patterns of teamwork skills that are reflective of collective efficacy?

**RQ3:** What are the patterns of taskwork performance between conventional and special operations U.S. Army combat squads?

**Assumptions of the Study**

Assumptions are the elements of information or structural framework that this research study has assumed to be true or self-evident (Roberts, 2010). Two primary assumptions arose at the outset of this study. The first assumption is that infantry soldiers from the conventional units and special operations forces (SOF) units are representative of soldiers from combat specialties in the U.S. Army. This assumption is reasonable based on recent data from the United States Department of Labor, Bureau of Labor Statistics (BLS). According to the BLS, combat specialty soldiers include infantry, artillery, and Special Forces (BLS, 2017).

The second assumption is that the subject matter experts (SMEs) who provided their expertise during the course of this study were not explicitly biased against conventional or SOF units. The SMEs who supported this study were high-ranking, noncommissioned officers actively serving in the Army. Both SMEs hold positions of great responsibility, have sworn an oath to the United States, and live by a creed of respect and honor. Additionally, the SMEs completed the Collaborative Institutional Training Initiative (CITI) training before participating in this study. While none of these facts prohibit one or both of the SMEs from deliberate deception, reasonable precautions were taken, and the researcher acknowledges any remaining risk to the study in this assumption.

**Delimitations and Limitations**

Delimitations and limitations are important, practical limits that set the parameters of the study (Creswell, 2014). Delimitations are the boundaries of a study and include intentional decisions by the researcher as to elements to include or exclude (Creswell, 2014; Roberts, 2010). For instance, time is a typical delimitation; studies have a beginning and an ending, which helps identify and control the scope of the research effort (Roberts, 2010). Limitations are potential weaknesses in a study or elements that may negatively impact the study's findings. Like delimitations, limitations are present in any study (Creswell, 2014; Roberts, 2010). The key difference between the two is that while the researcher has control over delimitations, limitations are outside of the researcher's span of control (Roberts, 2010).

**Delimitations.** The primary delimitation of this case study is the specific time that the study took place (Creswell, 2014). Specifying the time period under exploration is a crucial element of case study research (Yin, 2018). This research effort utilized raw and archival data collected during a previous experiment: the SOvM study. The SOvM study occurred in June of 2016 and was bound by its timeline. The SOvM database is massive; it includes multiple soldier measurements, such as cognitive workload, soldier motivation, and a test of prior knowledge (J. H. Johnston, personal communication, February 25, 2019). These elements of the database are sufficiently covered in the original SOvM Phase II report and are outside the scope of this study. The researcher further narrowed the scope of the study by focusing specifically on the antecedents of team performance.

**Limitations.** There are two main limitations of this study. The first limitation is the use of archival data that, even with robust datasets, may have gaps, holes, or missing elements (Jones, 2010; Rudestam & Newton, 2015). Additionally, while the raw data collected during the

2016 SOvM study was examined in new and useful ways, no new data can be collected from the soldiers who previously participated.

The second limitation is the choice of research design in the original SOvM study. All of the raw data originated from the SOvM study, and limitations in the original design impact this study. For example, using a nonequivalent posttest-only control group design introduced some limitation to this study, as the control group received no alternative to the intervention (Creswell, 2014). A possible criticism of using this type of design to explore performance is the potential that any improvement in team performance could be attributed to the increased team exposure rather than to the design of the intervention.

## Significance of the Study

**Addressing gaps in the current literature and refining conceptual framework.** Currently, the literature has not fully explored potentially meaningful areas related to the team performance of U.S. Army soldiers. The team attributes of collective efficacy and team cohesion are known to affect team performance (Sottilare et al., 2017). If measured at all, those attributes are collected statically through self-report surveys. However, self-report data is known to be subject to validity issues. For example, it is limited by both participant ability to be introspective and honest as well as by the ability to understand a question in the way the researcher intended.

Findings from this study can inform refinements to the conceptual framework put forward by Sottilare et al. (2017). Currently, the conceptual framework does not account for how antecedents of teamwork performance emerge in domain-specific environments. The patterns of team cohesion and collective efficacy identified during this study elucidate how teamwork antecedents impact team dynamics and emerge via behavior markers in the Army domain. The Sottilare et al. (2017) framework has not been applied to soldiers in a field environment.

Findings from this study demonstrate the utility of behavioral markers in applied field settings. Additionally, findings from this study help to address Sottilare et al.'s (2017) request for "future research to strengthen the confidence in the findings" (p. 237).

Static measures can only be administered before or after training, creating only snapshots of the degree to which and of how quickly team knowledge is emerging. Static measurements do not suffice to capture the nuances of emergence in team performance (Grand et al., 2016; Kozlowski, 2015), and academic analysis of the dynamic properties of teams is only beginning to appear. To further the literature, more robust assessment tools are needed. This study bridges theory and application by examining how dynamic measures of team attributes can augment field observations.

**Improving practice.** Findings from this study can improve practice and training in the Army. The U.S. Army faces a variety of enemies (e.g., state and non-state actors, terrorist groups, and hybrid threats), each with different capabilities (U.S. Department of the Army, 2014). The complex environment and the speed with which situations change necessitate a force that is agile and adaptive. To get the most out of training at the combat team level, soldier teams need debriefs that address team performance from the holistic perspective that includes both teamwork and taskwork skills. However, current team debriefs neglect teamwork skills, focusing instead on only taskwork skills and procedural steps, (Sawyer & Deering, 2013; Townsend et al., 2018).

This study addresses measurement shortcomings in practice evaluation. Informing the development of measurement tools can improve the ability of evaluators to accurately assess training programs (Kozlowski & Chao, 2018). Accurately assessing training programs is critical information for Army leaders. For instance, if behavioral markers more accurately measure team efficacy and team cohesion, the critical components of team performance, then training programs that employ behavioral markers would be better positioned to make a connection between the training program and its intended result.

Intuitively making the leap between team cohesion and its effect on team performance can be simple. However, empirically evaluating the connection between team cohesion and team performance is more difficult. This study explains the link between intuition and empiricism. By linking the intuitive elements of team performance to how they emerge in practice via behavioral markers, this study informs practitioners in the field how to more accurately assess the intended criterion (Sottilare et al., 2017).

Findings from this study can improve practice in both education and social science. Researchers who collect data in a field environment can improve their tools and instruments by combining objective measurements with self-reports. Researchers of soldiers can utilize the SME rating scale developed during this study to enhance field observations. Researchers who study other populations can follow a similar process to develop rating scales specific to the phenomenon of interest. Including objective measures with survey data improves a study's reliability and enhances its utility (Kormos & Gifford, 2014).

**Informing policy.** Findings from this study can aid Army policymakers as they develop strategies to measure and assess squad performance. Readiness is a top priority of the Army (Berglund & Filiberti, 2017). Maintaining or improving readiness is predicated on measuring and assessing the current level of preparedness (U.S. Army PEO STRI, 2014; U.S. Department of the Army, 2017d). This study informs the development of improved measurement tools that can aid assessment at the squad level.

Army teams need to be agile and adaptive (U.S. Department of the Army, 2014, 2017b, 2017c). Findings from this study can improve Army decision-making as leaders strive to implement procedures that cultivate teamwork skills at the squad level. Teamwork skills have a measurable impact on team performance (Brown & Overly, 2016; Read & Charles, 2018). Antecedents of team performance like cohesion and efficacy may improve soldiers' abilities to perform in dynamic environments.

This study can inform Army policymakers within the U.S. Army Training and Doctrine Command (TRADOC). Army TRADOC is tasked with updating the concepts, strategies, and techniques to train and educate soldiers (U.S. Department of the Army, 2017c). As new threats and technologies emerge, TRADOC modifies training techniques and practices to ensure the Army can meet and defeat near-peer adversaries. Decision-makers at TRADOC stand to benefit from a more complete understanding of the mechanisms of teamwork and performance at the squad level.

## Definitions of Terms

The following terms are used throughout the study. These terms help to contextualize the phenomena under examination within the Army domain. They may be defined differently in other literature where they are used in another context. These terms represent key elements of this study, so it is important that they are clearly identified and defined here to prevent confusion.

**Army team.** The term refers to an integral unit of four U.S. Army soldiers comprising either a team leader, rifleman, grenadier, and automatic rifleman or a squad leader, a medic, and two team leaders (Mundweil, 2013).

**Collective task.** The term is described as a "clearly defined, observable, and measurable activity or action that requires organized unit performance, leading to the accomplishment of a mission or function" (U.S. Department of the Army, 2012, p. 25).

**Individual taskwork.** The term is described as "Components of a team member's performance that do not require interdependent interaction with other team members" (Salas et al., 2008, p. 541).

**Sharing.** The term is described as "The act of transmitting information known by a team member to one or more team members" (Grand et al., 2016, p. 1358).

**Task.** The term is described as a "clearly defined and measurable activity accomplished by individuals and organizations . . . specific activities that contribute to the accomplishment of encompassing missions, or other requirements" (U.S. Department of the Army, 2003, p. 78).

**Team learning process.** The term is described as the process of "data selection, encoding, decoding, and integration" (Grand et al., 2016, p. 1356).

**Team performance.** The term is described as a "multilevel process (and not a product) arising as team members engage in managing their individual and team-level taskwork and teamwork" (Salas et al., 2008, p. 541).

**Team sharing process.** The term is described as the process of "member selection, retrieval, sharing, and acknowledgment" (Grand et al., 2016, p. 1356).

**Teamwork.** The term is described as "the coordination, cooperation, and communication among individuals to achieve a shared goal" (Salas, et al., 2015, p. 5).

## Organization of the Study

This study is organized into five chapters, a reference list, and appendices. Chapter 1 introduces the study and includes an overview of the background of the issue in the context of

Army combat squads. The background overview leads to the problem statement that focuses the study on the issue of taskwork, teamwork, and performance. The problem statement is followed by the purpose of this qualitative case study, which was to explore teamwork skills of selected combat soldiers in training situations in the Southeastern United States.

Chapter 1 continues with an overview of the conceptual model which frames the qualitative study by providing a linkage between team cohesion, collective efficacy, communication, and team performance (Sottilare et al., 2017). Following the framework are a description of the methodology and a rationale for method selection. The methodology is followed by a sequential list of research questions the study seeks to answer. The researcher then provides an overview of the set of assumptions made at the outset of the study.

Following the assumptions is a set of delimitations and limitations. The delimitations function as study boundaries, while the limitations describe potential weaknesses of the study (Creswell, 2014). The researcher then provides a list of definitions of terms that are relevant to the phenomenon of the study but that the reader may not be familiar with. The definitions are followed by the organization of the study which briefly describes each major section of the dissertation and serves as a guide for the reader.

Chapter 2 presents a review of the relevant literature including team cognition, shared mental models, team attributes, and team knowledge emergence. Following the topical literature review is a discussion of the conceptual framework and its concepts (i.e., team cohesion, collective efficacy, communication, and team performance). Chapter 3 identifies and describes the methodology and methods utilized to answer the study's research questions. Chapter 4 illustrates and presents data analysis and findings. Chapter 5 includes the major findings and conclusions as well as suggestions for future research. The study concludes with the reference list and appendices.

**Chapter Summary**

Soldiers must be educated, trained, and prepared to conduct a wide variety of tasks, such as combat patrol, humanitarian relief, insurgent raid, and local key-leader engagements. These tasks are executed in complex situations that require soldiers to adapt quickly to new information in highly stressful situations. Traditional training review methods are focused on taskwork and procedural outcomes that do not sufficiently address the critical teamwork elements that impact performance in complex situations. Teamwork is a dynamic process, yet only static measurements are used in attempting to capture and measure cohesion and efficacy, the attitudes inherent in teamwork. The purpose of this qualitative case study was to explore taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States.

The conceptual framework of the study narrowed the scope of the problem to focus on team communication and team attitudes. The problem, purpose, and conceptual framework led to the creation of the following overarching research question: What are the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States? This study used a single-case embedded design on a 2016 database. A case study was suitable to answer the research questions because observing teamwork attitudes in a field environment empirically linked the context with the observation. Further, an embedded design facilitated data collection at the team level to help to explain squad-level tactical performance. The researcher concluded that teamwork skills are fundamental to the performance of Army combat squads, a conclusion supported by findings in the patterns of performance between conventional and SOF combat teams.

# Chapter 2: Review of the Literature

While the literature on teamwork as an outcome is robust, a new facet of research examines teamwork as an emergent, process-based phenomenon. Kozlowski and Klein (2000) were the first to identify the emergent phenomenon in teamwork, stating "A phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon" (p. 55). In the context of Army teams, defining teamwork as emergent shifts the emphasis to a team's process of development. In other words, as soldiers work together, they develop cognitive, affective, and behavioral characteristics unique to the team; team cognition, a shared mental model, is an emergent *cognitive* team construct, team cohesion is an emergent *affective* team construct, and communication is an emergent *behavioral* team construct (Kozlowski, 2018). Given the complex interactions of team performance, measuring these team constructs as they emerge in a field environment is predicated on examining the individual actions of information sharing between team members (Grand et al., 2016), with the focus on how the constructs develop over time.

This chapter explores recent academic findings in teamwork literature, how the relevant concepts are measured and assessed, and what effect they have on team performance. Each of these elements is relevant to and aligned with the research questions examined in this study. First, to understand the patterns of teamwork skills that represent team cohesion and collective efficacy, each of these concepts must be defined and analyzed. Second, to explore the patterns of taskwork performance in selected Army units, the broader context of these concepts needs to be understood.

Central to this literature review is a comprehensive analysis of the issues related to dynamic measures of teamwork as an emergent phenomenon. The goal of this analysis is to identify measures that can help assess teamwork as an emergent phenomenon in Army teams. To accomplish this goal, it is helpful to understand the recent theories of team cognition and performance as well as how the literature has evolved over time. Furthermore, understanding how each of the individual concepts is defined and measured is vital to the application of this framework to Army teams in a field environment. To address each of these guiding objectives, the researcher systematically reviewed the literature. The review includes a database search, applying exclusion criteria, and employing deductive coding.

## Topical Literature Review

To frame this study, it was necessary to review the work of experts in team performance such as Kozlowski (1998) and Cannon-Bowers (2000). Kozlowski (1998) and Cannon-Bowers (2000) have analyzed, studied, and documented the nuances of team performance over several decades. This set of multi-disciplinary research studies broadly concluded that cognitive, psychomotor, and non-cognitive factors all contribute to tactical performance (Baard et al., 2014; Driskell et al., 2017; Kozlowski, 1998, 2006, 2018; Salas et al., 2008; Salas, Kozlowski et al., 2017). Situational awareness, sensemaking, and framing, which are cognitive factors, as well as the psychomotor factor of technical and procedural proficiency—though important determinants of tactical performance—are for this study less significant than the non-cognitive factors of teamwork skills and team efficacy. Teamwork skills and team efficacy comprise the attitudes and skills identified by Sottilare et al. (2017) to be directly connected to teamwork performance as its antecedents. Identifying the concepts of team cohesion and collective efficacy as antecedent to teamwork performance facilitates their exploration in this study.

The TKE is a recent theory of team cognition. It is instructive to examine this recent theory in detail as it represents the most recent trends in the domain of teamwork skill and performance. The TKE was codified in the article entitled "The Dynamics of Team Cognition: A Process-Oriented Theory of Knowledge Emergence in Teams" (Grand et al., 2016). In that article, Grand et al. (2016) pioneered the model that serves as an exemplar of the current research and reflects recent advances in team cognition and performance research. The foundation of TKE is built on the two central tenets of learning and sharing. Grand et al. (2016) conceptualized team cognition in a manner that allows for the examination of different models of team debriefs as well as the comparison of varying methods of measuring emergence. This study examined the taskwork-only model of team debriefs in its differences with the teamwork and taskwork model of team debriefs, and it compared static and dynamic measures of emergence.

Emergence is the central process on which TKE is based, while knowledge is a central construct. Grand et al. (2016) identified team knowledge emergence as the dynamic process by which team members communicate among each other, choosing which information to share and with whom. The dynamic element of TKE is in part what separates this theory from the rest of the field. The TKE categorizes team knowledge into two types: internalization and externalization. Internalization is characterized by the quality, quantity, distribution, and variability of information *known* by individuals; externalization is characterized by the quality, quantity, distribution, and variability of information *acknowledged* by individuals (Grand et al., 2016). Crucial to the transition from internalization to the externalization of emergent team knowledge is the communication, sharing, and acknowledgment of team members.

In TKE, learning and sharing are conceptualized as both individual and team-based processes predicated upon collaboration (Grand et al., 2016). The TKE breaks down the two central tenets of learning and sharing into eight constructs: "data selection, encoding, decoding, integration, member selection, retrieval, sharing, and acknowledgement" (Grand et al., 2016, p. 17). For example, during Army training, individual team members focus their attention on environmental cues and stimuli. They *selectively* perceive their environment, then *encode* the stimuli into their short-term memories. During *decoding*, the individual learns from the team, as opposed to self-processing of environmental cues (Grand et al., 2016). Decoding constitutes receiving information from other team members who have processed their environmental stimuli, while integration refers to the individual's processing of internal and external inputs (Grand et al., 2016). The TKE thus provides opportunities to explore both how the processes interact during team activities and why those interactions promote the generation of team knowledge (Grand et al., 2016; Kozlowski, 2018). In contrast, static data collection only allows researchers to postulate on team cognition after the process has occurred, thereby limiting any analysis to observations of what has already happened. The new opportunities from TKE provide researchers with a model to investigate the underpinnings of team performance by asking more probing and detailed questions on emergent team knowledge and team cognition (Kozlowski, 2018).

The TKE model put forth by Grand et al. (2016) serves as an exemplar of the recent teamwork and team performance literature. In this seminal document, TKE was used to analyze (1) how team information is shared, (2) how frequently team members communicate, (3) which team members are communicating, and (4) what information they are sharing. Of these four determinants, the TKE model stipulates that communication frequency and content of information shared are two of the most critical in team communication (Grand et al., 2016). Although TKE is based on a foundation of research that extends back for decades, the theory in its current construct is relatively new. The authors acknowledged that this seminal work in team knowledge emergence may not capture "all the possible influences related to team knowledge emergence" (Grand et al., 2016, p. 1378). However, the authors did identify and expound "core concepts and processes that constitute team knowledge emergence" (Grand et al., 2016, p. 1378) with the assumption that future research will refine the foundation developed in the original work.

**Team cognition.** Army teams share information during taskwork to accomplish objectives. Teams, particularly those such as U.S. Army teams in austere environments, rely on team members to conduct tasks that facilitate group progress or transmit and share information (Blaser & Seiler, 2019; Macht & Nembhard, 2015). Team cognition is the state that emerges from iterative sharing and learning as members interact over time (Grand et al., 2016; Kozlowski, 2015; Passos et al., 2015; Zajac, Gregory, Bedwell, Kramer, & Salas, 2014). Sharing information can be particularly challenging in austere environments, making team cognition difficult to achieve (Bartone et al., 2018; Salas, Vessey, et al., 2017).

Team cognition is inherently challenging to conceptualize. While cognition (e.g., thinking, brain processing) is intuitive at the personal level (i.e., individual), this process is more difficult to discern in the team context (Gevers, Uitdewilligen, & Passos, 2015; McNeese & Reddy, 2017). Early models conceptualized team-level cognition as the extent of overlap in information or knowledge shared among the team. This outcome-based approach to team cognition is inherently static. Newer models conceptualized team-level cognition as a process, not an outcome, which frames team cognition as a dynamic, emergent property (Abrantes, Passos, Cunha, & Santos, 2018; Fernandez et al., 2017; Kozlowski & Chao, 2012).

Conceptualizing team cognition as a process rather than an outcome influences the measurement method (Crichton, 2017). Empirical studies that identified team cognition as an outcome rightfully utilized static measurement methods, such as Likert-style self-reports, before and after training (Cooke et al., 2004; Salas & Fiore, 2004). However, more recent publications that identify team cognition as a process necessitate dynamic methods capable of measuring team cognition as it emerges (Kozlowski & Chao, 2018). While some progress has been made with, for instance, computer-based simulations and other cognitive frameworks, defining appropriate methods for measuring emergent team cognition has been challenging (Kozlowski, 2015). The interactions of team members on the multiple possible levels within any particular unit, whether individual-to-individual, individuals-to-individuals, or individual-to-team, (Kozlowski et al., 2013, 2016) creates a complex convergence of task performance, team knowledge, and team communication difficult to tease apart (Cooke, 2015; Fiscella, Mauksch, Bodenheimer, & Salas, 2017; Haar, Li, Segers, Jehn, & Bossche, 2015).

Outcome-based views of team cognition take a top-down approach to theory and measurement by examining the outcome at the highest level and assuming supporting actions were taking place. Previous attempts at measurement examined only the highest level and assumed that sub-levels occurred based on the observations of top-level outcomes. For example, in the U.S. Army, collective tasks focus on the objectives and outcomes at the highest echelon of a battalion, brigade, or division. (U.S. Department of the Army, 2017a, 2017b). This simplified structure enables Army leaders to quickly identify specific key performance parameters, such as maneuver, fire, or effects, but it does not provide the details necessary to advance research.

In contrast to the top-down, outcome-based task methods, a bottom-up, emergence-based, process-oriented view of team cognition measurement provides the data fidelity necessary for empirical studies (Kozlowski & Chao, 2018; Wildman et al., 2014). Team cognition has been shown to predict as much as 6.8% in the variance of performance above other factors like team affect or team motivation (DeChurch & Mesmer-Magnus, 2010; Guchait, 2016; Wildman et al., 2014). Since team cognition is a significant influencer of team performance, the data fidelity provided by process-based methods of measuring team cognition benefits U.S. Army teams. Because team cognition is such an essential factor in team performance, providing researchers and practitioners with viable methods of measurement is crucial to standardizing and evaluating interventions.

**Team communication.** Communication and the sharing of information has a strong, significant effect on team performance (Aubé, Brunelle, & Rousseau, 2014; Marlow et al., 2018; Mesmer-Magnus & Dechurch, 2009). In communication literature focused on performance, two main aspects are considered: unique information sharing and openness of information sharing. Unique information sharing is characterized by information residing in a single team member who shares his knowledge with the team. Openness of information sharing relates to the frequency and degree of sharing, regardless of its uniqueness—in other words, openness includes the sharing of information even when it is already held by other team members (Marlow et al., 2018).

Measuring communication objectively is challenging (González-Ortega, Díaz-Pernas, Martínez-Zarzuela, & Antón-Rodríguez, 2014; Tang, Jeon, & Choo, 2016). For instance, not all communication is overt or even verbal (Boies, Fiset, & Gill, 2015; Gardner, Gino, & Staats, 2012). The ways a team communicates can change over time, and some high-performing, experienced teams communicate more subtly than novice teams (Poysa, Elen, & Tarhonen, 2016). In an Army context, a squad composed of new team members without training in communication skills may share both important and unimportant information over the radio. Conversely, experienced teams with training in communication skills can communicate as much with a head nod or other subtle gestures as novice teams can in five minutes of radio chatter (Hanley, Kedrowicz, Hammond, & Hardie, 2018; Marlow et al., 2018). All sharing is not equal, and the inequality of information complicates its connection to performance (Aubé et al., 2014; Brewer & Holmes, 2016; Marlow et al., 2018; Song, Park, & Kang, 2015). Oversharing low-quality information detracts from team performance because the recipients must distinguish trivial information from meaningful (Ellwart, Happ, Gurtner, & Rack, 2015; Gardner et al., 2012). Structured assessments and team communication training can improve performance outcomes, reduce stress, and improve team taskwork (Hanley et al., 2018; Häske et al., 2018).

**Teamwork skills.** The literature review revealed two primary domains of empirical studies focused on teamwork skills: medical trauma teams and military teams. Within both the medical and military contexts, teamwork skills training reduced errors during task execution (Brown & Overly, 2016; Read & Charles, 2018). The course curricula in both the medical and military communities focus on knowledge accumulation and task proficiency rather than teamwork skill development (Brown & Overly, 2016; Reinemann et al., 2015). However, simulations predicated on developing teamwork skills have shown to be a reliable, repeatable method of training and measuring skill development (Murphy, Curtis, & McCloughen, in press; Smith, Farra, Ten Eyck, & Bashaw, 2015).

Research on teamwork skills training has demonstrated improvement of performance outcomes (George & Quatrara, 2018; Riojas & Austin, 2017). Additionally, teamwork skills training improves performance over time and has shown resilience to degradation (George & Quatrara, 2018; Hoang et al., 2016; Reinemann et al., 2015). Relevant to combat soldiers, teamwork skills improve performance outcomes in dynamic and austere environments (Riojas & Austin, 2017; Valdiri, Andrews-Arce, & Seery, 2015). Teamwork skills are essential for Army combat teams, but systematically assessing those skills in field environments has proven to be challenging (Kozlowski, 2015; Kozlowski & Chao, 2018).

**Conceptual Framework**

The conceptual framework used during this study is based on a recent meta-analysis from the journal article titled "Designing Adaptive Instruction for Teams: A Meta-Analysis" (Sottilare et al., 2017). The objective of the research was to develop a real-world framework for teams by examining behaviors that promote productive performance (Sottilare et al., 2017). The original article aimed at creating a foundational model to aid the development of team learning and training with respect to performance. The study team analyzed the databases of PsychINFO, defense technical information center, and ProQuest for articles containing relevant keywords between the years 2003 and 2013 (Sottilare et al., 2017). The initial search yielded a total of 5991 articles; these articles were filtered through their inclusion criteria, leaving a final dataset of more than 300 primary studies (Sottilare et al., 2017).

Sottilare et al. (2017) used a meta-analytic structural equation modeling procedure to "assess relationships of attitudes, cognitions and behaviors to team performance, learning, satisfaction, and viability" (p. 231). While Sottilare et al. (2017) included satisfaction and viability during the initial literature search, the relationship of these two to attitudes, cognition, and behavior was weaker than that of team performance and learning. As such, the remainder of the study focused on team performance and learning as the salient outputs. The meta-analysis showed that team cohesion and collective efficacy explained significant variance in team performance, 20% and 15% respectively (Sottilare et al., 2017).

**Development of the conceptual framework.** Given the recent development of this conceptual framework, it is instructive to examine its academic lineage. The individual elements of learning (i.e., to encode, to select, and to decide), as well as the individual elements of sharing (i.e., to acknowledge, to retrieve, and to share), are fundamentally linked to IPT. The IPT presents human learning as the accumulation of knowledge through encoding information (Thomas, 2005). Early IPT conceptualized human learning as analogous to memory systems of modern computers in which information is encoded to be retrieved when needed. Generally, theories based on IPT include the informationally-based constructs of input, output, store, process, and retrieve (Thomas, 2005).

Team knowledge, group knowledge, and team cognition have been prevalent ideas in social psychology for decades (Salas, Kozlowski, et al., 2017; Salas, Vessey, et al., 2017). Theorists (e.g., Wegner, 1987) have mainly advocated "group mind" philosophies. The central idea was that the group mind is both intuitive and measurable. The group mind is intuitive in that groups contain individuals with similar attitudes, beliefs, and worldviews (Mell, Van Knippenberg, & Van Ginkel, 2014), and it is measurable in that the group-mind philosophies seek to capture the degree of "within-group similarity" (Wegner, Giuliano, & Hertel, 1985, p. 254).

Wegner (1987) discussed the virtues of the transactive memory system and distinguished it from these group mind philosophies. For instance, Wegner (1987) noted, "the study of transactive memory is concerned with the prediction of group (and individual) behavior through an understanding of the manner in which groups process and structure information" (p. 185). Wegner (1987) built upon notions of IPT to develop his model of individual cognition. His three constructs of the individual mind are encoding, storage, and retrieval. The transactive memory system as described by Wegner et al. (1985) accounts for both the individual and the collective. Individuals have a single-level cognitive process for their own minds, and through communication, share with other close members of the group.

Many researchers built upon the original work of Wegner et al. (1985). The Wegner et al. (1985) original work was a single-level model of memory and cognition that served as the foundation for later multi-level theory (Kozlowski et al., 2013, 2016) and theories of knowledge emergence (Grand et al., 2016). Research into transactive memory systems influenced group organizational structure (Austin, 2003), team innovation (Peltokorpi & Hasu, 2014), and team performance (Mell et al., 2014). Because the TKE model builds on earlier group knowledge research, the work of Wegner et al. (1985) was important to the development of TKE as put forth by Grand et al. (2016). What separates TKE is its dynamic, process-based approach to knowledge emergence.

The seeds of the conceptual framework were planted in the early research of training adaptive teams (Kozlowski, 1998) and tactical decision-making in stressful situations (Johnston et al., 1998). From there, Kozlowski and other contributors integrated concepts of cohesion (Kozlowski & Ilgen, 2006) and team effectiveness (Kozlowski & Chao, 2012). As the underlying concepts continued to evolve with more research, concepts of field studies (Spiker & Johnston, 2013), behavioral markers (Kozlowski et al., 2013), and team cognition (Wildman et al., 2014) were integrated and adapted.

**Conceptual framework concepts.** As mentioned in Chapter 1, the conceptual framework put forward by Sottilare et al. (2017) includes the following concepts: collective efficacy, team cohesion, trust, communication, coordination, and leadership. According to the Sottilare et al. (2017) model, all six of these concepts are antecedents of team performance.

Sottilare et al. (2017) emphasized collective efficacy, team cohesion, and communication, the three concepts which formed the conceptual framework for this study. Sottilare et al. (2017) highlighted collective efficacy, team cohesion, and communication as specific antecedents of team performance, justifying a need to focus on these concepts for this study. Each of the concepts are enumerated in the following paragraphs.

***Trust.*** Trust is a component to effective teamwork and team performance (Boies et al., 2015; Paul et al., 2016). Trust incorporates two main elements: "positive expectations and the willingness to become vulnerable" (Sottilare et al., 2017, p. 241). High-functioning, effective teams have teammates who trust each other in addition to the team leader (Boies et al., 2015). In the Army context, trust fosters open and effective communication. Open communication has a synergistic effect with team cohesion that lays the foundation for effective team performance (Paul et al., 2016).

***Coordination.*** Coordination plays a role in teamwork (Paul et al., 2016; Salas, Reyes, & McDaniel, 2018). High-performing individuals who do not coordinate well together perform poorly as a team (Il-Hyun, 2012; Salas et al., 2018). Team coordination is the effective interaction among team members to accomplish a shared objective (Mathieu, Hollenbeck, van Knippenberg, & Ilgen, 2017). In the Army context, coordination is accomplished through hand signaling, radio transmissions, and voice communication (U.S. Department of the Army, 2012).

***Leadership.*** Leadership training in teams has a measurable effect on team performance. The size of the team and the experience of its members can affect the style of leadership that optimizes performance (Bachrach & Mullins, 2019). Additionally, deliberate training in leadership behaviors has been shown to increase performance in dynamic teams (Roberts et al., 2014). Leadership skills synergize with other team attitudes, such as team cohesion and collective efficacy, and teamwork skills (e.g., communication and coordination) to affect performance in a meaningful way (Boies et al., 2015; Lacerenza, Marlow, Tannenbaum, & Salas, 2018; Sottilare et al., 2017).

***Communication.*** Communication is a necessary and critical skill in successful team performance (Lacerenza et al., 2018). Teams in high-stress medical trauma units trained in communication techniques and behaviors have shown improved performance that persists over time (Roberts et al., 2014). More than the other antecedents of team performance, communication is an important factor both in terms of its relevance and its quality (Sottilare et al., 2017). Teammates that communicate at a high frequency, particularly with information not germane to the task, over-burden teammates (Ellwart et al., 2015; Gardner et al., 2012). In contrast, teams that quickly and effectively communicate critical information outperform teams that overshare low-quality information (Ellwart et al., 2015; Lacerenza et al., 2018).

***Team cohesion.*** Recent literature demonstrates that team cohesion is both a significant predictor of and antecedent to team performance (Asamoah & Grobbelaar, 2017; Bayraktar, 2017; Kozlowski & Chao, 2012; Salas et al., 2015; Sottilare et al., 2017). Earlier research posited that team cohesion comprises the degree of unit interconnection between two constructs: social cohesion and task cohesion. Task cohesion is defined as “a team’s shared commitment to a group goal” (Salas, Fiore, & Letsky, 2011, p. 42). Task cohesion elevates the level of effort put forth by the team members. Salas et al. (2011) defined social cohesion “as the group members’ attraction to or liking of the group; it allows groups to have less inhibited communication and to effectively coordinate their efforts” (p. 42). While both social and task cohesion are important, recent research has explored new ways to conceptualize team cohesion (Kozlowski & Chao, 2012).

More recent research approaches team cohesion as a multidimensional construct (Salas et al., 2015). A recent meta-analysis concluded that "62% of 104 studies measuring cohesion in the military did measure cohesion unidimensionally" (Salas et al., 2015, p. 19). While these unidimensional self-reported Likert scales are useful, they fall short of objectively measuring team cohesion or how it develops over time (Salas, Vessey, et al., 2017). More recently, team research has focused on the multisystem (MTS) approach to cohesion. Rather than separating the elements of social cohesion and task cohesion into two different constructs that can emerge independently, MTS unifies social cohesion and task cohesion.

The MTS approach, described as "all forces acting on a network of teams that allow and enable the network to operate and coordinate as a synergistic entity" (DiRosa, Estrada, & DeCostanza, 2015, p. 30), allows the measurement of team cohesion to extend to its impact beyond one team. Interteam cohesion is the interaction between teams, and intrateam cohesion is the interaction within a single team. Under the MTS system, both interteam cohesion and intrateam cohesion must be present for synergistic cohesion to emerge in a team (Estrada & Severt, 2015; Mesmer-Magnus & Dechurch, 2009). The MTS approach to team cohesion is especially relevant in the military context. The U.S. Army teams who form the foundation of this study are organized into squads. Squads form platoons, and platoons compose companies. With the MTS approach, team cohesion must exist both within the team and within the larger organizational structures (Salas et al., 2015). For example, a platoon's cohesion is affected by the cohesion of its squads and teams.

***Collective efficacy.*** Recent literature continues to demonstrate that collective efficacy is another significant predictor and antecedent of team performance (Fuster-Parra, García-Mas, Ponseti, & Leo, 2015; Lee, Stajkovic, & Sergent, 2016; Park, Kim, & Gully, 2017; Rapp, Bachrach, Rapp, & Mullins, 2014; Sottilare et al., 2017; Xiong & Fang, 2014). Collective efficacy is sometimes referred to in the literature as group efficacy or team efficacy. The recent literature on collective efficacy explores subsets of the behavior with particular attention to how collective efficacy forms (Lee et al., 2016), how leadership impacts collective efficacy (Xiong & Fang, 2014), and how to measure collective efficacy (Fletcher, Wilkinson, Bladon, & Gargiulo, 2017). Additionally, the potential curvilinear effects of collective efficacy have also been studied (Fuster-Parra et al., 2015; Park et al., 2017; Rapp et al., 2014).

Emerging research indicates that collective efficacy improves performance but only to a point. Both Park et al. (2017) and Rapp et al. (2014) suggested that a curvilinear model of collective efficacy is more representative of its effect on team performance. A potential implication of a curvilinear model is that collective efficacy at extreme levels can negatively impact performance. Park et al. (2017) suggested that overconfidence in team ability may lead to rigidity in cognitive problem solving. Another possibility is team complacency; for instance, teams with excessive collective efficacy may assume positive results without diligently applying the process that led to previous successes (Rapp et al., 2014). Teams with excessive efficacy may be less likely to change course, even if issues with the current process are identified earlier. These examples point to a rigid mindset less adaptable to change due to previous successes. Alternatively, Park et al. (2017) noted that team cohesion could moderate some of the curvilinear effects of high collective efficacy. In a similar study, Rapp et al. (2014) suggested that team goal monitoring could moderate the negative effects of high collective efficacy.

Collective efficacy is an emergent team behavior (Kozlowski, 2018; Lee et al., 2016), which has two potential implications. First, emergent attributes warrant increased measurements to capture the rate of change as emergence occurs; otherwise, researchers risk missing the nuance of attribute development (Kozlowski, 2015; Park et al., 2017). Second, collective efficacy is more than the sum of measurements of individual self-efficacy: it emerges as an outcome of group interaction and dynamic group behavior (Lee et al., 2016; Rapp et al., 2014; Xiong & Fang, 2014). Since team processes can fluctuate dynamically during task execution, data should be collected frequently enough to ensure that the entire range is captured, not just the high or low points (Kozlowski, 2015).

Behavioral markers, as used in this study to explore teamwork skills and teamwork performance in dynamic environments, present an opportunity to increase the data capture rate. As Kozlowski (2015) noted, “if the rate of measurement is slower or lags the process rate of change, then one will fail to capture nuances in the change or may even miss important process phenomena” (p. 278). Therefore, there is a potential to miss meaningful nuances that correlate to team performance when taking only pre-training and post-training measurements. Kozlowski (2015) also noted that “capturing processes will generally require higher sampling frequencies than are typical” (p. 278). Increasing the sampling frequency of the traditional, static measurement tools is not practical for field experiments. More frequent use of questionnaires and surveys would interfere with the soldiers executing the mission. Additionally, traditional questionnaire and survey measures are time consuming, susceptible to response bias, and may promote participant withdrawal (Kozlowski, 2015).

**Development and refinement of the conceptual framework.** The development and refinement of the Sottilare et al. (2017) conceptual model originated from a goal to mitigate challenges in student-to-instructor ratios through intelligent tutoring systems (Sottilare, Holden, Brawner, & Goldberg, 2011). The idea that student learning outcomes can increase with the addition of intelligent tutoring systems has rapidly progressed through the beginning of the 21st century, due to advances in computers and technology (Sottilare et al., 2011). Furthermore, since Bloom's research in the 1980s, the idea of a one-to-one student-to-teacher ratio has shown to improve learning outcomes (Sottilare & Proctor, 2012). However, while a one-on-one student-to-teacher ratio is advantageous to learning and improves performance, it is not realistic and may be resource cost-prohibitive (Dermeval, Paiva, Bittencourt, Vassileva, & Borges, 2018; Kulik & Fletcher, 2016). An intermediate step between one-to-one and one-to-many ratios is intelligent tutoring. Intelligent tutoring systems exhibit some of the advantages of a reduced student-to-teacher ratio but at a more affordable resource cost (Kulik & Fletcher, 2016; VanLehn, 2011).

The Sottilare et al. (2017) conceptual model was also refined from a reliance on passive collection techniques to the use of behavioral markers. The authors transitioned from capturing student attitudes and moods through the tracking mouse movements, heart rate detection, and keystroke recognition to linking specific behavioral markers to learning and performance (Sottilare & Proctor, 2012). In 2012, Sottilare and Proctor found that "previous experience, training and topic interest were not among those predictors of performance" (p. 111). However, other behavioral indicators, such as mood, were found to be predictive of performance. The authors concluded that future research should include exploring more robust behavioral measures and rely less on self-reports and surveys (Sottilare & Proctor, 2012). Sottilare and Proctor (2012) are not alone in their recommendation for furthering research in this topic. Recent studies have called on experts studying team performance and team effectiveness to conduct more empirical field studies. For instance, Bush, LePine, and Newton (2018) suggested that team performance research would benefit from "a naturally occurring field experiment in which one set of teams receives a training intervention on the types of team task transition processes they might encounter, while another set of teams receives no training" (p. 9). The SOvM dataset provides precisely what Bush et al. (2018) advocated: a field experiment in which the control group received no training. The SOvM experimental group was provided training in team debriefs that included both taskwork and teamwork elements, while the control group received a taskwork-only debrief.

The use of behavioral markers instead of Likert scales continues to be promoted in research. Bush et al. (2018) is one example of recent research that provided conceptual support for the use of dynamic measures instead of static measures. Bush et al. (2018) suggested dynamic measures are better than static measures when assessing team performance via task transitions. In another recent publication, Goodwin et al., (2018) called for future research into military team performance, including how both teamwork and taskwork impact team dynamics. As noted previously, Kozlowski (2015) argued that video and audio are ideal methods for capturing dynamic team processes.

**Conceptual model focuses attention on the problem.** The conceptual model provided by Sottilare et al. (2017) served as a framework to focus attention on the problem. The conceptual model facilitated an investigation into how teams communicate. Specifically, the conceptual model was used to explore how team information is shared, how frequently team members communicate, which team members are communicating, and what types of information they are sharing. The conceptual model suggests that markers for team cohesion and collective efficacy are two of the most critical factors of team communication that tie directly to team performance (Sottilare et al., 2017).

To capture team-level processes in real time, Kozlowski (2015) advocated for the use of video and audio technology because of the richness of the data. He stated, “video and audio recording are highly flexible forms of data collection. By definition, they capture team process behavior as a stream of continuous data. Thus, they have high potential for mapping the dynamics of team processes" (Kozlowski, 2015, p. 286). The use of an instrumented site is a necessity for the level of fidelity in data required.

The conceptual model thus necessitates using behavioral markers as dynamic measures to capture team attributes. The inclusion of behavioral markers for dynamic measurement is also supported by Grand et al. (2016) through their TKE, which highlights the importance of team member communication. Grand et al. (2016) found "which and how often [team] members share information is as—if not more—critical to the development of team knowledge emergence than what information gets shared" (p. 1377). By identifying these concepts as the drivers of team performance, the conceptual model thus narrowed this study's focus to team cohesion and collective efficacy and predicated the study's acquisition of the video and audio files.

**Conceptual framework justification.** The conceptual framework provided a lens to explore the topic, purpose, and research questions under investigation in this study. The framework aligned with this study by providing a model of how team cohesion and collective efficacy influence communication and affect team performance. This conceptual framework is well-suited because it advocates for the inclusion of behavioral markers as a means of quantifying and qualifying team-based attributes. Kozlowski (2015) acknowledged the value of dynamic measurement, which behavioral markers provide, to better explore team processes. He recommended that research "supplement traditional questionnaire-based measurement with alternative assessment tools . . . [since] one of the primary limiting factors in efforts to capture process dynamics is the dominance of questionnaire-based measurement in our research designs" (p. 292).

Grand et al. (2016) provided theoretical support for the conceptual framework by advocating for the use of uninterrupted measurement tools. The TKE model provides theoretical support for the use of dynamic measurement tools to measure team knowledge as it emerges rather than after it has occurred. The TKE posits that when studying emergent behaviors and skills in teams, dynamic methods such as behavioral markers and other unobtrusive measurement tools are preferable to static methods (Grand et al., 2016; Kozlowski, 2018). Furthermore, Kozlowski (2015) succinctly summarized the limitations of static measurement tools: "Questionnaires are obtrusive; they interrupt the stream of behavior. They are subject to response biases; biases that are exacerbated by repeated measurements. And, they are time consuming; they are inherently limited for high frequency sampling rates" (p. 292).

The conceptual framework thus provided a mechanism to explore patterns of teamwork skills within the Army context by providing the foundational concept of linking team cohesion and collective efficacy to team performance through communication. The patterns of teamwork skills that reflect team cohesion and collective efficacy were essential questions in this study. Training in teamwork skills focuses on reinforcing what information to share and how often it should be shared (Grand et al., 2016). These two elements—content of information and the rate of frequency—are the core concepts of the TKE. Debriefs that emphasize teamwork help educate soldiers on communication facilitation that is not present in taskwork-only debriefs (Allen, Reiter-Palmon, Crowe, & Scott, 2018; Grand et al., 2016). The conceptual framework supported this examination by providing a lens to aid the development of research question RQ3.

**Related research.** Team researchers have only recently begun to examine the dynamics of emergent team attributes and cognition, but it is having an impact on a broad range of topics and ideas. The conceptual model has support from researchers in a variety of fields, including virtual and simulation technologies (DeCaporale-Ryan, Dadiz, & Peyre, 2016), medical and health professionals (Grand, 2017), and combat training in the U.S. Army (Milham et al., 2017). The conceptual model is also influencing current research in combat casualty care, integrated training approaches, and communication in virtual teams (Fernandez et al., 2017; Marlow, Lacerenza, & Salas, 2017; Milham et al., 2017).

The article entitled "Socially-Shared Cognition and Consensus in Small Groups" examined shared tasks in groups that intend to resolve an issue or make a decision, as opposed to simply producing work or following procedures (Levine, 2018). The author examined shared task accomplishment through the lens of information sharing, conflict resolution, and team mental models. As with the conceptual model, this research shows that the type of information teams share is an antecedent of successful performance. For instance, teams prone to sharing common knowledge, to which all team members had access via the team mental model, were less successful in solving problems than teams that shared unique information (Levine, 2018).

Groups who did not have a shared team mental model were less successful than teams who did share a common mental model. The success of teams with shared mental models supports previous research on the dynamics of both team cognition and team efficacy (Kozlowski & Ilgen, 2006). Previous research showed that teams with high-performing individuals who do not share a mental model do not perform as well as less experienced teams who do share a mental model (Il-Hyun Jo, 2012). These conclusions have implications for both education and training curriculum development (Cannon-Bowers & Salas, 1990; Smith-Jentsch, Cannon-Bowers, Tannenbaum, & Salas, 2008).

Kozlowski (2015) suggested that the research community must move toward research designs that observe team knowledge emergence over time. Longitudinal designs, however, are much more resource-intensive and thus have largely been avoided. The SOvM dataset, while not a true longitudinal study, does include multiple measurements taken between iterations. The multiple iterations of measurement in M2 and M3 allow insights into the processes of emergence that the single snapshot designs of other experiments cannot. Although the research field would undoubtedly benefit from a longitudinal empirical study, the SOvM study serves as an intermediate step that advances the field.

**Limitations of the conceptual model.** The primary limitation of the conceptual model is that it does not account for the collective, pooled knowledge of teammates or sufficiently account for team attitudes at the individual level. The term “team knowledge” often serves as a general model that comprises different concepts. Two such concepts are team mental models and transactive memory (TM; Kozlowski et al., 2013). Team mental models are “organized mental representations of the key elements within a team’s relevant environment that are shared across team members” (Mohammed & Hamilton, 2010, p. 877), and TM is the “combination of the knowledge possessed by each individual and a collective awareness of who knows what” (Austin, 2003, p. 866). An important distinction particularly relevant to team performance is the acquisition of new team members. As new teams form or new members join, they do not share a unified mental model (Kozlowski et al., 2013).

Team member knowledge exists through a range of possibilities. In the Army context, new squad members do not share the same knowledge or mental model as their more experienced peers. In part, this is why team knowledge necessitates dynamic measurement and capture (Kozlowski et al., 2013; Mohammed & Hamilton, 2010). As an emergent process, team knowledge exists on a continuum from neophyte to experienced squad leader. To successfully measure team knowledge, the construct needs to be flexible enough to accommodate many different points on the continuum of knowledge emergence, not just fixed points (Grand et al., 2016; Kozlowski, 2015; Kozlowski et al., 2013). Currently, the only way to accomplish this empirically in field studies is through direct observation.

Despite the prevalence of team knowledge and team cognition research over the last 15 years, there is ambiguity as to its definition and concepts (Cooke et al., 2004; Fernandez et al., 2017; Wildman et al., 2014). The ambiguity exists in three domains: concept, process, and methodology (DeChurch & Mesmer-Magnus, 2010; Kozlowski & Chao, 2012). In the research, there are two conceptual designs for approaching team cognition: externalized interactions and shared mental models (Cooke, 2015; Wildman et al., 2012). The shared mental model approach accounts for team-based inputs and outputs by incorporating elements of traditional IPT (Wildman et al., 2012). Opponents of IPT-based philosophy disagree with the human mind as a computer analogy as too simplistic to describe the inner workings of human cognition (Gurbin, 2015). Moreover, opponents often claim that treating learning as information processing allows for a limited range of truly useful knowledge (Richland, Chan, Morrison, & Au, 2010; Schwartz, Boduroglu, & Gutchess, 2014). Opponents of IPT would prefer a more inclusive definition of what is true and what is worth knowing.

The externalized interaction approach is rooted in observing behaviors that represent or are characterized by the cognitive processes of team cognition. Fundamentally, this approach distinguishes team knowledge from team cognition. Notably, not all researchers (e.g., Cooke,

2015) have defined team cognition according to the same parameters. The research lacks consensus on whether team knowledge is distinct from team cognition or if they are synonymous. Up until the most recent publications, these distinctions have not been made (Cooke, 2015; Cooke et al., 2003; Wildman et al., 2014). For example, Grand et al. (2016) did not differentiate between team cognition and knowledge in the same way as Cooke (2015), who specifically defined team cognition as interaction. However, Grand et al. (2016) did acknowledged that both TM systems and shared mental models may be factors in team cognition in certain contexts.

Behavioral markers are a more objective means of observing team attributes; however, as a measurement tool, they are not without their limitations. For example, behavioral markers may not fully enable the observation of every salient criterion within a domain (Borman & Smith, 2012; Sottilare et al., 2017). If important elements that compose cohesion are not included in the behaviors, then observations of cohesion will not represent a complete and accurate depiction of the marker. The more gaps between the behavior and the criterion, the less accurate the behavioral marker. This phenomenon is known as criterion deficiency and can be mitigated through robust testing and analysis (Borman & Smith, 2012),

A second limitation of using behavioral markers is the potential for bias (Sottilare et al., 2017). Recent advances in artificial intelligence and intelligent tutoring systems show promise for psychomotor tasks, such as Army marksmanship (Goldberg, Amburn, Ragusa, & Chen, 2018). Despite these advances, artificial intelligence is not presently capable of identifying more nuanced behavioral markers, such as the team cohesion and collective efficacy exhibited by Army soldiers in a field environment. Until that technology is developed, human observers are required. However, as human observers are introduced into the situation, so is the potential for bias. This limitation can be mitigated through observer training, but the realities of field research may preclude extensive observer training prior to an event (Bailey & Bailey, 2017).

**Chapter Summary**

The literature review explored recent academic findings concerning the challenges in cognition, communication, and performance. The academic findings bring into focus the challenges Army combat teams face when operating in dangerous and austere environments. Success at the squad level may depend on coordination and communication among all team members, but soldiers are not explicitly educated and trained in these skills. This study explored patterns of teamwork skills reflective of team cohesion and collective efficacy in order to lay a foundation to address these soldier issues.

Chapter 2 described the concepts that compose the study's conceptual framework: team cohesion, collective efficacy, communication, and team performance. Each of the concepts was carefully examined. The researcher discussed how each of the concepts was measured and assessed in addition to how each had an impact on team performance. This chapter also discussed intelligent tutoring systems as the academic origin of the conceptual framework as well as the contributions to the topic different authors made over time.

Chapter 2 included a justification for utilizing this conceptual framework. The researcher described why the conceptual model was appropriate for the qualitative exploration of patterns of teamwork skills that reflect team cohesion and collective efficacy. Additionally, the researcher enumerated the reasons why the framework was appropriate to illuminate the patterns of performance in Army combat squads. Finally, Chapter 2 described how this study can inform both practice and policy for the Army while also addressing empirical gaps in the current literature.

# Chapter 3: Procedures and Methodology

The purpose of this qualitative case study was to explore the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States. The following overarching research question discussed was the following: What are the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States? To answer the overarching research question, the researcher developed the following research sub-questions:

**RQ1:** What are the patterns of teamwork skills that are reflective of team cohesion?

**RQ2:** What are the patterns of teamwork skills that are reflective of collective efficacy?

**RQ3:** What are the patterns of taskwork performance between conventional and special operations U.S. Army combat squads?

This chapter outlines the methods and procedures used to collect and analyze the data. The chapter presents an overview of the research design, articulating the chosen methodology for this study, identifying its strengths and weaknesses, and explaining why this is a suitable design for this study. The chapter continues with a description of the site selection, population, sample size, and selection method of the data. This study utilized an existing dataset in novel ways to explore pressing questions in both academia and in practice. Next, the chapter covers potential ethical issues and permissions and then examines each of the major sources of data. For each of the sources of data, a description of the research protocol or instrumentation is included, and the researcher reviews how the data was analyzed. The chapter closes with a brief summary.

## Research Design

Qualitative research entails systematically observing a phenomenon within the context of those who experience it firsthand (Yin, 2018). Creswell (2014) characterized qualitative research as "an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (p. 4). Under the broad category of qualitative research are a number of research designs that can help to answer questions or topics proposed by a study. A few such qualitative designs are phenomenological research, narrative research, grounded theory, ethnography, and case study (Yin, 2018). Phenomenological research is a description of a phenomenon as told by individuals who experienced it (Creswell, 2014). Narrative research is a collection of life stories by an individual or group (Denzin & Lincoln, 2000). Grounded theory is a procedural approach to social theory development (Yin, 2015). Ethnographies are a blend of "close-up observation, rigorous theory, and social critique" (Yin, 2015, p. 53). A case study is a thorough analysis of an event over a specific time period (Yin, 2018).

As this study utilized a case study design, an additional description of this particular type of research is warranted. Yin (2018) defined case study as "an empirical method that investigates a contemporary phenomenon (the 'case') in depth and within its real-world context" (p. 15). A case study is appropriate to answer the research questions of this study because it would not be possible to separate the elements of observation (i.e., team cohesion and team efficacy) from their context. That is, teamwork skills in Army teams are contextual, so their emergence is predicated on many different factors. These factors are not easily controllable as would be needed in an experimental research design. Yin (2018) further determined that a case study is useful when there is a "technically distinctive situation in which there will be many more variables of interest than data points" (p. 15).

All research designs, whether mixed methods, quantitative, or qualitative, have potential strengths and weaknesses. Quantitative design strengths include larger sample sizes and robust statistical procedures to determine differences between groups or associations between variables.

However, there are weaknesses as well. By incorporating only numerical data, some of the nuance in responses is lost. By contrast, qualitative research collects rich, descriptive datasets but typically lacks the larger sample size of quantitative studies. More specifically, quantitative designs are efficient at statistically enumerating the difference between groups, but qualitative studies are better adept at explaining how or why the differences emerged.

Within case studies, there are several design types that a researcher can employ. Yin (2018) noted that the four most prominent types of case study designs come in a 2 x 2 categorical model: holistic or embedded and single-case or multiple-case. Single case studies are appropriate when the phenomenon is extraordinarily critical, rare, or common. While the latter two examples may seem contradictory, a rare case is worth exploring because of its unique nature, while a common case may be worth exploring because of its effect on a large portion of the population (Yin, 2015). Multiple case studies are essentially multiple experiments that observe the same phenomenon. The research community views multiple case studies as more robust because multiple cases increase the reliability of the study's findings (Yin, 2018). Additionally, case studies can be embedded or holistic. Embedded studies involve data collection at subunits to help explain the phenomenon at higher echelons, while holistic studies take a broad, all-inclusive approach to the phenomenon (Yin, 2018).

This study uses a single-case, embedded-design approach to explore the research questions and topic. The case this study examines, the SOvM database, is sufficiently unique to warrant careful exploration. The database is unique because large-scale quasi-experimental teamwork and performance-based research studies in a field environment are rare, and rarer still are field studies that include special operations soldiers. The researcher examined the four subunits within the database before returning to the broader context of the Army combat squad.

Figure 2 is a visual representation of the research design and the relationship between the embedded units and the overall context.

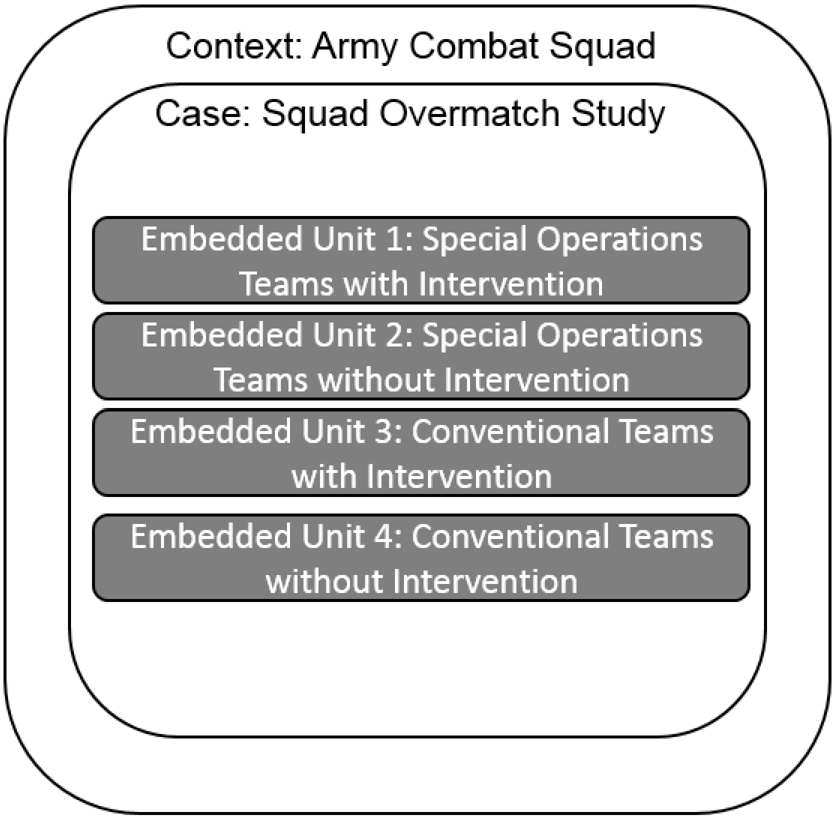


*Figure* 2: Author's overview of research design.

Given the reliance on a database as the primary source of data, it is instructive to examine the design that precipitated the development of that database. The 2016 SOvM study collected data based on a nonequivalent posttest-only control group design. In this type of design, the experimental group receives an intervention, in this instance education and training, and the control group receives nothing (Creswell, 2014). Following the experiment, both groups took a posttest; in this case, a combined training exercise (Creswell, 2014). The study produced a rich dataset that was ripe for further exploration through a case study; furthermore, it is impractical or unrealistic to replicate. The SOvM 2016 database is both robust and complete, with detailed audio and video data of a live-action military exercise. The audio and video captured during the live portion of the experiment facilitated the examination of the overarching research question.

In the 2016 SOvM study, the participants were not randomly selected or assigned; the soldiers in the study had already been assigned into squads. Since the participants were already divided into preformed groups, a quasi-experimental selection design was appropriate (Creswell, 2014). Quasi-experimental designs are not unusual in the applied sciences, particularly as they relate to active duty soldiers. Soldiers in conventional and SOF infantry Army teams, while similar, are different enough to make the prospect of randomly assigning members to a team both unrealistic and undesirable. Furthermore, the dictates of traditional chain of command and unit-standard operating procedures make the random assignment of participants difficult. Nevertheless, teams from conventional and SOF units were represented in both the control group and the experimental group.

**Weaknesses.** Lack of rigor is one of the most commonly cited weaknesses of single-case studies (Yin, 2018). This weakness is not inherent to the case study method; instead, it lies in how the researcher applies rigor to the method. More than other methodological choices, case studies are susceptible to shifts in design during data collection. Researchers utilizing a case study design should be acutely aware of these shifts and be ready to revise the data collection plan if the focus has inadvertently transitioned from the original topic of study or phenomenon (Yin, 2018).

The researcher addressed the potential weakness of the case study design by employing a rigorous approach to the phenomenon under exploration. Utilizing an embedded-design approach facilitated a systematic data collection of the smaller subunits, the Army teams, and focusing on the subunits before returning to the larger unit, the Army squad, enabled an in-depth analysis and exploration of the issue. Additionally, SMEs helped design the instruments used to capture observations. The SMEs' instrument design input along with the instrument review process ensured observations were conducted consistently and with a uniform standard.

In addition to the methodological weaknesses of case studies, utilizing a dataset from a previous study raises two additional liabilities. First, this study relied on raw archival data, a reliance which some may view as a weakness. Second, there was a weakness inherent in the original design structure—the nonequivalent posttest-only control group—since the control group received nothing while the experimental group received the intervention. The increased exposure of the experimental group, rather than the specific intervention applied during the experiment, may explain the differences between the groups. A mitigating factor for the external validity of this study was that past field research had already shown that teamwork training, as compared to taskwork training alone, improves tactical performance (Cannon-Bowers et al., 1995; McEwan, Ruissen, Eys, Zumbo, & Beauchamp, 2017; Smith-Jentsch et al., 2008). Therefore, having more time to train would not have increased the likelihood of better tactical performance in terms of teamwork skills.

A potential hazard to utilizing embedded units as the focus of a study is that the research may become too entrenched in the subunits and not relate those units to the overarching case (Yin, 2018). During analysis of subunits, it is critical for the researcher to return to the broader phenomenon) of interest, the original case identified for the study. One of the major challenges and potential weaknesses of case studies is to define and clarify the case or phenomenon of interest appropriately. However, the challenge of defining the case was primarily mitigated in this study because the case was encapsulated in the database under exploration.

**Strengths.** Case studies, as a research method, can be particularly adept at exploring the complex phenomenon of small groups. Given the multiple interactions involved in team performance, examining field research of Army teams via case study rests on a strong conceptual and practical foundation (Yin, 2015, 2018). The case study method is the preferred method for examining "a case within its real-life context" (Yin, 2006, p. 1).

One strength of an embedded unit case study is that it helps maintain the focus of the study (Yin, 2018). Holistic case studies, by contrast, can trend toward being too abstract (Yin, 2015). According to Yin (2018), abstraction circumvents the utility of findings for practitioners; without an anchor for practitioners to focus on, holistic studies can drift into obscurity or make recommendations that are either unrealistic or unactionable. Overall, the strength of this embedded unit design was its ability to utilize the rich, complete, and recent dataset from a large-scale live experiment to explore a real-world problem. Additionally, using video and audio files mitigated the potential bias of the research team. The strength of the pragmatist worldview was flexibility and openness in viewing both the overarching research question and the methods available to answer the question.

**Quantitative methods.** While this is a qualitative study, several quantitative methods were used to explore the research questions, specifically RQ3. Utilizing quantitative methods in a case study with embedded subunits is encouraged by experts in the field (Yin, 2018). In fact, Yin (2018) took encouragement a step further, suggesting that a case study with embedded units that does not include quantitative analysis may lack rigor and be subject to alternate interpretations of the analysis. Therefore, adequately answering RQ3 necessitated the review and analysis of quantitative performance data. The following describes the database, permissions, sources of data, data collection, and data analysis techniques used for the three research questions in this study.

The methods used to explore RQ3 require additional clarification; in particular, a description of the condition and the variable is warranted. There are two conditions relevant to RQ3: control and experimental. The control condition received no intervention, while the experimental condition received the debrief intervention. Debrief training and education occurred before scenario M2, after scenario M2, and after scenario M3. The condition was a categorical variable attributed at the team level. The dependent variable for RQ3 was the team performance score. In this single-case embedded design, the dependent variable was measured twice: once after the first scenario (M2) and once after the second scenario (M3). Performance scores were derived from SME subjective rating of tasks completed during the scenario and were measured at the team level.

There are two groups of units relevant to RQ3: conventional and SOF. A conventional unit type is one that conducts tasks associated with conventional forces. More specifically, the higher command element is associated with conventional Army service component commands (e.g., Army Central Command, Army Northern Command, and Army European Command), not Special Operations Command. A team's unit is a categorical variable attributed at the team level. The major quantitative limitation of the study was its relatively small sample size. The researcher analyzed the data of 64 individuals composing 21 teams. Each team was measured twice: once during scenario M2 and once during scenario M3. The small sample size may affect the generalizability of these findings to other infantry soldiers and teams.

**Database Description**

This case study utilized an existing database to study archival video and audio files that depicted the subject phenomenon in the Army context. As such, a description of how the database was developed and a brief history of the individuals involved are warranted. The SOvM program began in 2013 as an Army Study Board-sponsored project. The stated objective of the study was to “evaluate training methodologies and technologies that could potentially reduce the magnitude of Post Traumatic Stress (PTS), PTS related suicides, and improve Soldier performance, resilience, and readiness” (U.S. Army PEO STRI, 2014, p. 1). The study’s human dimension aspect of soldier performance included situational awareness training and resilience skills (U.S. Army PEO STRI, 2014). The study made sufficient progress and accomplished the original objectives by December 2014.

The original study garnered enough interest that a three-phase follow-on study began shortly thereafter during the first quarter of 2015, sponsored by the Office of the Secretary of Defense Joint Program Committee (Johnston et al., 2016). The Joint Program Committee is a congressionally directed medical simulation and information science research program that aims to improve healthcare through innovation and research (J. H. Johnston, personal communication, February 25, 2019). Phase I of the SOvM study focused on tactical combat casualty care (TC3).

The overarching goal of the three-phase study was to “improve individual and team performance, tactical decision making, communications, and TC3 under stressful conditions to improve mission effectiveness and reduce preventable combat deaths” (Johnston et al., 2016, p. 2). Phase I was conducted at Ft. Benning, GA, in 2015, during which a study team demonstrated technologies (e.g., simulation-based training and TC3) as well as methods (e.g., integrated training approach and team development) suitable for improving training outcomes (Johnston et al., 2016). The key concepts of the integrated after-action review were team cohesion and behavior correction. Feedback from soldiers and Marines who participated in the study was overwhelmingly positive. Survey data from Phase I found that “98% of the Soldiers and Marines felt the scenarios would help prepare them for combat” (Johnston et al., 2016, p. 3).

Phase II began shortly after the conclusion of Phase I. The raw and archival video footage from the Phase II live experiment served as the database for this study. The scenario portion of the experiment was conducted at the McKenna Urban Training Facility. The scenarios were complex military operations developed in response to feedback gleaned from surveys of soldiers returning from combat duty in Iraq and Afghanistan. The scenarios included several prototype technologies (e.g., 3D digital enemy projections, interactive avatars), pop-up targets, pyrotechnics, olfactory sensory input (e.g., smell generators), combat audio inputs (e.g., gunfire recording, simulated artillery munitions), trauma mannequins, and live actors and role-players.

**Population**

The United States Department of Labor, BLS identified 101,873 active-duty enlisted personnel within the combat specialty (BLS, 2017). According to the BLS, combat specialty soldiers include infantry, artillery, and Special Forces. While not a perfect representation, the number of active-duty enlisted serves well as the total population for this study.

Soldiers in SOF units and those in conventional units with the same infantry Military Occupational Specialty (MOS) are an appropriate sample of the population of enlisted soldiers with a combat specialty. However, it is worth noting a requirement unique to the selection and recruitment of these two units. The SOF units require a selection or an assessment to gain entry to the organization. Not all enlisted soldiers with an infantry MOS are subject to these requirements; but since the total population of infantry soldiers must be able to perform the same core set of individual and collective tasks, the 64 individuals who participated in the original study are a representative sample of the total population of U.S. Army infantry soldiers with an infantry MOS.

**Participants**

Sixty-four soldiers participated in the SOvM study. The participants from the SOvM database used during this study consisted of 64 soldiers composing 21 teams. Demographic data were gathered from the participants, and the soldiers who participated in this study reflect the age, gender, and time in service of the larger population of infantry soldiers. Participant characteristics of age, time in service, and MOS are representative of the primary problem this study explores within the total population. Participating units included the following:

- U.S. Army, 3rd Infantry Division, Ft. Benning, GA;
- 82nd Airborne Division, Ft. Bragg, NC;
- U.S. Army, Special Operations Forces, Location Redacted;
- U.S. Army 316th Cavalry Brigade, Ft. Benning, GA; and
- U.S. Army, 690th Medical Detachment, Ft. Benning, GA.

The 72 soldiers in the original participating units composed 24 teams. Of the original 24 teams, three teams with a combined total of eight soldiers were eliminated because of insufficient data. The remaining 21 teams comprised nine experiment-condition teams and 12 control-condition teams. Each team conducted two scenarios, resulting in a total of 42 observations. The 21 teams were evaluated with respect to patterns of team cohesion, efficacy, and performance described above.

For the purposes of this study, squads were divided into three teams. Organic rifle teams in the U.S. Army (i.e., team leader, rifleman, grenadier, automatic rifleman) formed two teams, each including a team leader, rifleman, grenadier, and automatic rifleman. The third team was composed of the two team leaders, the squad leader, and the medic. This breakout structure, depicted in Figure 3, resulted in 21 total teams for analysis, nine of which were assigned to the experimental condition, and 12 of which were assigned to the control condition. Both conventional unit teams and SOF unit teams were represented in the control and experimental conditions.

| | | Unit Type | |
|---|---|---|---|
| | | Conventional | SOF |
| Condition | No Intervention | 6 | 6 |
| | Intervention | 6 | 3 |

*Figure 3:* Total of 21 teams disaggregated by unit type and condition.

The participants were aligned with the unit from which their team originated, so no conventional unit teams were intermixed with SOF unit teams. Then, conventional teams combined to represent a typical squad in the U.S. Army: one squad leader, two team leaders, two automatic rifleman, two grenadiers, and two riflemen. Each squad was assigned a medic from the 690th Medical Detachment. The SOF teams also combined to represent a typical squad in the U.S. Army; however, the SOF units had teams comprised of three soldiers, while the conventional units had teams comprising four soldiers.

**Participant Selection**

A single-case, embedded-design approach facilitated the exploration of teamwork skills and performance. To answer the questions outlined in this study, the researcher obtained archival experiment data from a 2016 field study (i.e., the SOvM study) conducted by ARL. The sample for this study included all participants from the 2016 field study. During the SOvM study, participants, who had already been assigned to their squads and units, were selected rather than assigned randomly, as they were already in preformed groups (Creswell, 2014). This selection method is not unusual in quasi-experimental designs, particularly in the applied sciences, and would be useful to any applied research where groups are preformed, such as in school districts, classrooms, or military units.

All available participants from the original SOvM dataset were used in this study; however, all available data for each participant were not included. With guidance from the original SOvM study principal investigator, the researcher selected specific data from within the database for examination. For instance, the database included detailed information on TC3 training and medical performance scores. This information was excluded as it was covered in great detail in the SOvM Phase II report.

Other data were also excluded. The database included surveys, knowledge tests, and self-report measures. This study's principal criterion for inclusion of data was that the data should be unaltered. Therefore, cleaned and analyzed data from the original SOvM database were excluded; only the raw video and audio SOvM files were included. The exclusion of any cleaned data mitigated the transition of bias from the original SOvM experiment to this study. The sole exception to this criterion is that the researcher included demographic data from the SOvM database. The demographic data were included because the benefit of understanding the population outweighed the risk of contamination.

**Ethical Issues and Permissions**

**Ethical issues.** Uniformed service members as well as veterans are vulnerable populations and are therefore considered protected classes of citizens by researchers and review boards. As such, the collection, storage, and manipulation of data from active-duty soldiers poses an ethical issue. For example, many of the demographics used during the SOvM study included detailed personal soldier information, including personally identifiable information (PII) as defined by the Department of Defense's (DoD) information security standards. The U.S. Army is especially sensitive to the collection, retention, and manipulation of this particular type of soldier data (i.e., PII).

This researcher took two actions to help mitigate the impact that PII and sensitive soldier information had on this study. First, this researcher entered into and signed a data sharing agreement (DSA) with ARL. A copy of the DSA can be found in Appendix A. The DSA explicitly states the need for and purpose of accessing SOvM data. Second, the data provided by ARL was stored in an external hard drive in a locked file cabinet. The hard drive was only accessed with a password-protected computer. Additionally, a senior scientist from ARL followed the progress of the study to provide DoD oversight and ensure that soldier PII information was protected.

**Permissions.** The issue of data ownership rights was mitigated to the greatest extent possible through the use of a DSA and a signed letter of approval from ARL (Appendix B). The DSA agreement is tied to the SOvM study and signed by the DoD component official; this agreement does not expire and pertains to all protocols, measures, and data gathered during SOvM. This agreement fully complies with DoD regulations regarding research involving human subjects and meets federal guidelines regarding the assurance and protection of human research.

The document was signed by this researcher, the ARL Institutional Review Board (IRB) Co-Chair, the Human Protection Administrator, and the Director of Human Research & Engineering Directorate. Additionally, the Principal Investigator and the Senior Scientist for the SOvM study support this dissertation study and provided a letter of approval which can be found in the appendices.

During data collection, several measures were taken to mitigate data spillage or unintended exposure of data. First, the raw data were stored on an external hard drive. When not in use, the hard drive containing the data was kept in a locked container. Second, the principal investigator maintained control of access to the data. Under a controlled setting, the principal investigator granted access to two active-duty Army SMEs who were allowed to view pertinent videos but not to control the data. The Army SMEs had to be able to view the video and audio of the SOvM study experiment in order to provide an assessment of the teams' tactical performance.

De-identifying the video files was not possible. The data were videos of military training exercises, and soldiers' last names are on their uniforms. To mitigate this issue, the Army SMEs completed CITI training, completed the co-investigator/other personnel application, and signed a confidentiality agreement. The data will be returned to the original study's principal investigator after the research is complete. Destruction of the data will comply with original IRB conducted by ARL. This study utilized an existing dataset, and the researcher was an engaged researcher on the original study. The researcher received a waiver of consent from the University of West Florida (UWF) IRB; as the study did not involve more than minimal risk, waiving informed consent did not adversely affect subjects' rights and welfare.

Two active-duty Army senior noncommissioned officers served as technical and tactical SMEs for this dissertation study. Their participation was necessary to evaluate the tactical performance of the Army teams as they conducted infantry tasks. To authorize the two SMEs to view the data from the SOvM study, they were assigned roles as co-investigators/other personnel and completed the applicable CITI certification training in accordance with UWF IRB requirements. The data collection tools the SMEs utilized during observation were developed by the researcher and SMEs through a review-revise process.

The behavioral marker measurement sheet (BMMS) and the SME performance rating measurement guideline (PRMG) were the primary data collection tools. The researcher developed both the BMMS (Appendix C) and the PRMG (Appendix D); therefore, no special permission was required. The researcher discusses the validity of the data collection tools during the description of the research protocol section. A supplement to the PRMG was the task checklist supplement sheet (TCSS). The researcher did not use the TCSS (Appendix E) as a measurement tool; instead, the TCSS provided a checklist to aid SME consensus and facilitated interrater reliably.

**The SMEs' background, experience, and qualifications.** The two SMEs who volunteered to participate in this study are senior noncommissioned officers, Rank E8. They are both ranked First Sergeant of their respective companies and each lead the technical and tactical training of a company of approximately 80–150 soldiers. Each of the SMEs has extensive combat experience, with both SMEs having served in 16 or more combat deployments to areas including Iraq, Afghanistan, and Syria. Each of the SMEs served more than 60 months of total deployment time in active combat zones over their 18 years of military service to the U.S. Army.

**Data Sources**

This study utilized three primary sources of data: archival data in the form of video, audio, and survey data from the original SOvM study, SME observations, and data collection sheets. The archival data include four sources of data, all of which originated from the SOvM dataset. The first archival data source was the complete audio file of the individual squad members collected during the live training scenarios in the original study. The second archival data source was the instrumented site video captured at McKenna Urban Training Facility during SOvM. The third archival data source was the video file of the after-action reviews. The fourth archival data source was the demographic survey data of the participants.

The second source of data was the SME observations. This study reviewed archival records as a primary source of data, utilizing SME observations as the means of observation and data collection. As such, it is important to review the strengths and weaknesses of the archival data as the source of evidence for observation. As archival information, video and audio data share a similar set of strengths. For instance, video and audio data can be repeatedly viewed as necessary without degradation; additionally, archival video is an unobtrusive way to observe participants in a field environment (Yin, 2018).

Despite the advantages, archival video and audio files as sources of observation have weaknesses as well. Video and audio data can be difficult to obtain, particularly when participants come from protected classes (e.g., children and prisoners). Also, there is the potential for bias in audio and video records if the original author is unknown. Both of these weaknesses were mitigated in this study, the first through a DSA's granting access to the raw audio and video footage, and the second because the original author was the principal investigator who oversaw the collection of the data.

Observations as a source of evidence have strengths and weaknesses as well. The strengths of observations include the ability to see participant behaviors within the context of the study. Observing behaviors in context is a valuable source of data that can lead to meaningful insights, interrelationships, and findings (Yin, 2018). The weaknesses of observations are that they can be time consuming from a labor perspective, and if outside observers are utilized, observer biases are incorporated into the observations (Yin, 2018). The SMEs, because of their familiarity with the Army context and because of their CITI training, provided a check to these weaknesses.

The third source of data was the data collection sheets. There were two primary data collection sheets and one supplemental sheet. The BMMS and the PRMG were the primary data collection sheets. The BMMS allowed the SMEs to capture the frequency of a behavioral marker in addition to where the marker occurred. The PRMG is a behaviorally-anchored rating scale used to quantify SME ratings of team performance. As mentioned, the TCSS was not used as a measurement tool; instead, it provided a checklist to aid SME consensus and to facilitate interrater reliably.

On October 11, 2018, the researcher received approval from the UWF IRB based on proposal number IRB 2019-026 (Appendix F). Once the researcher received UWF approval, the researcher began collating video and audio data for the SME team to review. Raw, unedited video files retrieved from the SOvM study provided the foundation for the performance evaluation. The video files included footage from multiple camera angles, depicted in Figure 4, of a mock urban village.


*Figure 4.* Overview of village external cameras. J. H. Johnston, personal communication, October 12, 2019. Reprinted with permission.

In addition to the external camera video feed, many of the buildings within the village had internal camera feeds. Figures 4 and 5 depict the extent to which the mock urban village was instrumented. The combined number of internal building and external video feeds gave the teams conducting the experiment up to 15 different angles from which to view the soldiers. While having multiple video feeds from a variety of angles helped produce a cohesive dataset, it also caused another problem: Observing the different video angles one at a time was tedious and sometimes unproductive. Often, the majority of any single video feed was dead air because no team was in view. Also, viewing the videos one at a time could produce a disorganized viewing of the operation. To ameliorate these issues, this researcher used the video editing software Adobe Premier Pro version cc2019 to merge the videos together. Merging the videos in this way produced a single, integrated video, instead of the multiple and incongruent videos with myriad start and end times, for more coherent SME observations.

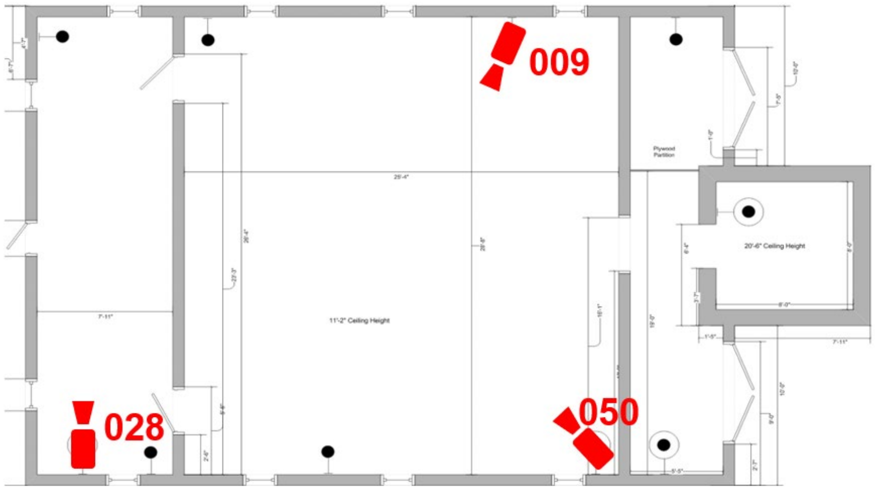


*Figure 5.* Example of internal video feeds of an instrumented building. J. H. Johnston, personal communication, October 12, 2019. Reprinted with permission.

The four sources of archival data described above were critical to this study. The audio files provided the raw data for SMEs to evaluate the teams' communication and to measure the frequency of behavioral markers. The video files provided the raw data for SMEs to evaluate the teams' tactical performance and to measure the teams' efficacy based on the performance protocol. The after-action review videos provided the opportunity for SMEs to further observe behavioral markers in a non-tactical setting. The soldier survey provided the researcher an opportunity to categorize the demographics of the study participants.

**Disadvantages.** There are potential disadvantages to using archival data, including incomplete or compromised data and data ownership rights (Jones, 2010; Rudestam & Newton, 2015). However, the potential for incomplete data was a minimal issue in this instance. While the SOvM study does have gaps in data, none significantly affected the voice communications. Gaps in audio files were mitigated by redundant sources of capture. For example, if a soldier had issues with his individual microphone, the video feed provided a redundant source of audio. Additionally, significant voice communication was typically captured during soldier-to-soldier radio transmissions; when one soldier's microphone may not have been working, other soldiers' microphones could capture the communication for the audio file, resulting in multiple redundant sources of important communication.

Yin (2018) provided a list of potential sources of evidence for case study research, including video data, which is the primary source of evidence of the study. As mentioned above, the urban village was fully instrumented, including cameras placed for multiple, overlapping angles both inside and outside buildings, and one moveable camera operated by a camera technician. Nevertheless, the camera positioning at times created small gaps in the video footage. When the SMEs were faced with such gaps, they relied on the audio feeds to determine what actions a team was taking.

**Advantages.** In general, the advantages of using archival data include access to rich datasets, access to information that may not be possible otherwise, access to the unique perspectives of personal diaries and journals, and longitudinal records (Jones, 2010; Rudestam & Newton, 2015). Specific to this research, there is a compelling rationale to utilize the existing database. The raw data collected during the SOvM study was immense. Sixty-four participants and dozens of data collectors, scientists, researchers, and Army personnel participated in the month-long experiment. Included in this data is a large collection of voice communications between team members as they executed a complex tactical mission. The mission area is fully instrumented with video and audio capture, and individual team members had microphones attached to their equipment. The data were primed for exploring patterns of teamwork skills exhibited during tactical combat in the context of soldier teams.

Having considered both the advantages and disadvantages of utilizing archival data for this study, the value of the archival data was clear. Tremendous efforts and resources were involved in the SOvM study, a fact which resulted in a coherent and rich dataset. The intensive personnel resources required for planning follow-up SOvM efforts resulted in a large set of audio and video footage that has not yet been thoroughly examined. The signed DSA, combined with the richness of unanalyzed data from the SOvM study, makes a uniquely compelling argument for the use of archival data for this research study.

The richness and completeness of the data was encouraging. The principal investigator and chief scientific lead on this study partitioned off sections of the data specifically for use in this study. The partitioning of the data prevented it from the possibility of being contaminated by other researchers examining different aspects of the exercise. Using this study's conceptual framework as the lens through which to evaluate the SOvM audio data, the researcher produced meaningful insights that further advanced the study of taskwork and its role in tactical team performance.

## Description of Research Protocol and Instrumentation

Two primary instruments were utilized in the collection of data: BMMS and PRMG. The behavioral marker measurement facilitated the exploration of RQ1 and RQ2. The BMMS used 10 markers to measure team cohesion and used 10 markers to measure collective efficacy. Each concept was measured by a frequency count of the observed behavior, and the researcher noted whether the behavior occurred during the mission or during the AAR. The PRMG facilitated the exploration of RQ3. The PRMG included a subjective rating scale developed by the researcher and the SMEs. The PRMG included a numerical scale from zero to six that ensured the SMEs used a consistent method of measurement. The development and collection procedures for each measurement tool are discussed in the subsequent sections.

**Team cohesion and team efficacy behavioral marker measurement.** To measure the teams' behavioral markers for cohesion and efficacy, the researcher consulted the literature to determine what experts in the field were currently using. Sottilare et al. (2017) performed an exhaustive meta-analysis of recent studies from 2003-2013 which reside in the public domain. Sottilare et al. (2017) included only those studies that involved small teams (i.e., less than nine members) and that contained sufficient data to correlate team measures. Their meta-analysis found that collective efficacy explained 20% of the variation in team performance, while team cohesion explained 15% of the variation. Sottilare et al. (2017) also produced a table of behavioral markers associated with team attributes that affect performance: "trust, collective efficacy, cohesion, communication, and conflict/conflict management" (p. 256).

Sottilare et al. (2017) followed a seven-step process to identify behavioral markers. The process included identifying constructs, searching the literature for measures, consulting with SMEs, and revising behavioral markers. Sottilare et al. (2017) created a table identifying behavioral markers associated with team measures that impact performance. The Sottilare et al. (2017) behavioral marker table provided the initial point of departure for this study's behavioral marker development. While Sottilare et al. (2017) focused on developing a set of markers that were applicable to a broad set of domains, this study focused on U.S. Army teams. Therefore, it was necessary to modify the markers originally identified by Sottilare et al. (2017).

This study used collective efficacy and team cohesion behavioral markers as dynamic measures corresponding with research that suggested they are antecedents of team performance. The study team completed an abbreviated version of the seven-step process described above to modify the behavioral markers identified by Sottilare et al. (2017). First, the research team narrowed the table to the most promising team attributes, collective efficacy and team cohesion. Second, the study SMEs jointly reviewed the measures and assessed them for suitability. Third, the SMEs revised the measures to better fit the Army context. Fourth, the research team conducted a pilot test with the protocol and revised the behavioral markers based on SME feedback. Fifth, the new set of markers was confirmed by a second pilot test. The resulting BMMS in Appendix C served as the protocol to assess the Army teams during data collection.

The BMMS contains descriptions of soldier behaviors that represent both positive and negative team attitudes. There are 10 markers that represent team cohesion and 10 markers that represent collective efficacy. For both team cohesion and collective efficacy, half of each set of 10 markers are positive and half are negative. For example, “soldiers work together” is a positive representation of team cohesion; “soldiers do not work together” is a negative representation of team cohesion.

The research team used the BMMS in Appendix C to collect the frequency of behavioral markers exhibited by soldier teams during each scenario and during each AAR. The BMMS has three columns. The left column identifies the category of marker, either team cohesion or collective efficacy. The left column enumerates each positive and negative representation of the markers in pairs. The center column and the right column identify where the marker occurred. The center column, titled “frequency observed AAR,” facilitated the SMEs in noting whether or not the behavior occurred during the AAR; similarly, the right column, titled “frequency observed mission,” facilitated the SMEs in noting whether or not the behavior occurred during the mission.

**Task performance measurement.** A second research protocol was used to score the teams’ task performance. The PRMG is a behaviorally-anchored rating scale used by the SMEs to numerically evaluate team performance on a scale from zero to six. The rating guideline helped ensure a consistent method of measurement was used by the SMEs throughout the data collection. The researcher and SMEs developed the PRMG iteratively during the two instrument reviews. The iterative revision process conducted with SMEs during instrument review constituted face validity of the scoring protocols (Phillips, Ross, & Shadrick, 2006; Phillips, Shafer, Ross, Cox, & Shadrick, 2006). The rating guidelines specify the difference in performance levels from poor to average to proficient. Descriptions distinguish the different categories of tactical errors as significant, moderate, or minor. Examples of ratings and descriptions of relevant combat tasks are also provided.

A supplement to PRMG is the TCSS. The research team relied on Army Field Manuals and technical doctrine for the TCSS. Army doctrine outlines precise tasks that must be accomplished at the squad level. The tasks support larger units and higher-echelon commands to accomplish their mission. It is critical to note that the task performance score is based on the behaviorally anchored rating scale from the PRMG, and the TCSS served only as a guide to help SMEs come to a consensus on a performance rating for a particular task. When there was disagreement on the performance rating among SMEs, the TCSS served as a guide to aid resolution and achieve consensus.

It is worth noting that the evaluation of tasks conducted by a team depended on decisions the team members and leaders made during a scenario. For example, the squad leader team typically conducted the conduct negotiations task; although it did occur once, it was unusual for alpha or bravo team to conduct that task. Additionally, a few tasks, such as the entering and clearing of a building or the treating of casualties, were typically conducted more than once per scenario; in some cases, a task was conducted up to three times. On average, teams conducted four tasks in scenario M2 and four tasks in M3.

Evaluating the team performance of dismounted infantry teams might pose challenges to researchers because there are multiple successful ways for a team to accomplish each scenario.

Mandating that certain teams conduct certain tasks would have likely normalized the performance scores; however, it would have introduced significant artificiality into the experiment, as infantry teams are not retrained or restricted in this manner during normal operations. Field research is particularly valuable in part because it more closely approximates real teams in their environmental context. As such, the benefits of assigning tasks to teams are outweighed by the costs of negative training and artificiality.

**Instrument Review**

As noted previously, specific steps were taken to validate the BMMS (Appendix C) and the PRMG (Appendix D), which were used as the collection instruments for the main study. First, a draft of the behavioral checklist was derived from the Sottilare et al. (2017) meta-analysis of teamwork behaviors. The researcher and the SME team revised the table of behavioral markers suggested in Sottilare et al. (2017) to include relevant behaviors in a military context. Next, the team conducted an analysis by observing the recorded video and audio from three teams that conducted the M1 scenario. The research team conducted the data collection, mirroring the process that was used in the main experiment.

Based on discussions with the SME team, the behavioral checklist was revised. Revisions included reducing the total number of markers from 13 to 10. However, the research team also added negative instances of the 10 remaining behavioral markers. For example, the initial draft included the marker *soldiers take responsibility for mistakes when they occur*. The second draft of the marker included both *soldiers take responsibility for mistakes when they occur* and *soldiers do not own up to mistakes when they occur*. The purpose of adding in the adverse behavioral marker as a corresponding negative was to capture and categorize behaviors more accurately as they were displayed.

After the research team completed the first analysis of three teams, the collection instrument was revised, and a second analysis of three other teams was conducted. The purpose of the second analysis was to confirm the adjustments made after the initial instrument review. After the research team watched video and listened to audio of the second set of three teams conducting scenario M1, the team concluded that no more changes were necessary and that data collection could begin.

During the development and validation of the BMMS, the research team also developed the PRMG (Appendix D) and the TCSS (Appendix E). The TCSS was derived from the task sheet, which is the current Go/No-Go checklist the U.S. Army utilizes to measure task competence at the collective level. The checklist, which is established U.S. Army doctrine, served as an aid for the SMEs as they rated the teams under review; the TCSS served to compare their ratings between one another and to facilitate consensus. The TCSS was used by the SMEs during both their first and second instrument reviews, which helped refine the procedural elements of collecting data and which also gave the SMEs confidence in their collection procedure. In addition, the two reviews served as an opportunity for the research team to practice the review process and to acclimate to the disparate audio and video elements that came from a variety of locations in the village.

**Data Collection Procedure**

The data collection procedures are outlined below for RQ1, RQ2, and RQ3. The first two research questions explored the patterns of teamwork skills that reflect team cohesion and collective efficacy respectively. The third research question examined patterns in performance among selected Army teams. The following paragraphs contain a description of the data collection timeline and a step-by-step account of how the research team collected the data.

As mentioned previously, the researcher received IRB approval on October 11th. To collect the data needed to address the research questions and complete this study, the researcher reviewed audio and video files and compiled a concise set of reference material for each team. The researcher used the remainder of October to collate the audio and video files into coherent elements. For both the control and the experimental groups, the researcher collated the audio and video files of each team's training scenario.

Approximately 37 hours of video footage from multiple angles were reviewed and prepared for analysis. The total raw video available for each squad varied slightly, depending on coverage and the decisions the squad made during the exercise. The researcher assembled the files into a group package. Approximately 60 hours of audio files were organized and synched to the corresponding video files before the entire dataset was optimized for analysis.

After the researcher collated the data files, he coordinated data collection meeting times with the SMEs. During the first two weeks of November, the research team met four times. The purpose of these meetings was to develop the data collection tools iteratively. Examples of the iterative tool development were covered in the instrument review section. Each review session lasted approximately four hours. After the end of the fourth session, the data collection tools were complete, and the research team developed a tentative data collection schedule.

On November 16th, the research team met for the first of seven data collection events. The data collection events lasted between four and 10 hours each. The researcher set up and organized the upstairs portion of his home for the SMEs to review the video and audio. The researcher streamed the video to a large flat screen television from his desktop computer. The SMEs sat in front of a table with paper printouts of the data collection tools. The SMEs used the data collection sheets to score teams as they reviewed the videos and listened to the audio files. The researcher controlled play of the video and audio from his desktop computer.

**Patterns of teamwork skills and team cohesion (RQ1).** The seven data collection sessions with the SMEs followed a predictable schedule. First, the researcher printed copies of the BMMS, PRMG, and TCSS. Second, the researcher organized the data collection sheets on the table in front of the video monitor. Once the SMEs arrived, they annotated the top portion of the data collection sheet to identify the scenario, the scenario date, the current date, and the SME's name. Third, the research team began data collection.

During the data collection sessions, the SMEs followed a consensus process in order to note an observed behavior. The SMEs discussed the behavior and came to a consensus on whether or not the behavior was salient within the Army context. The consensus process frequently required replaying sections of video and audio. If the SMEs reached consensus, they noted the marker on the data collection sheet; if the SMEs did not reach consensus, the researcher resumed the video and the SMEs continued the observation.

During the mission, the audio files included as many as 11 audio channels. Therefore, merely knowing when a behavior occurred was insufficient for the research team to quickly and accurately relocate the behavior for retrieval. When a behavior during the mission was noted by the SMEs, the researcher coded the date, scenario, time, and audio channel; the researcher also noted a key word or phrase of the behavior to facilitate retrieval and analysis. For example, to code the behavioral marker that occurred on June 17th during the mission M3 at 48.5 minutes on audio channel Bravo with the keyword "bomb," the researcher recorded "17 JUN, M3, 48.30, B, bomb."

The SMEs reviewed the video and audio files, observing the 21 teams as they participated in Scenario 1. The research team reviewed all of the Scenario 1 files recorded for M2 before moving on to Scenario 2 in M3. Each scenario was roughly 45 minutes; however, the video and audio had to be replayed frequently to ensure the salient points of the scenarios were captured and recorded accurately. A typical review of Scenario 1 took 90 minutes. After reviewing all of Scenario 1, the SMEs reviewed the platoon-leader-led AAR. The AARs typically lasted 30–45 minutes, but because they were conducted in a classroom and not in a combat scenario, the SMEs were able to review this section of data with less replay and thus more efficiently than the live-action simulation of the scenario.

While reviewing the AAR, SMEs continued to observe the soldiers for evidence of behavioral markers. The consensus approach used during the mission evaluation was also used to evaluate behaviors during the AAR. When one of the SMEs observed a behavioral marker during an AAR review, the researcher paused the video, and the SMEs came to a consensus. The SMEs then noted the behavior on the data collection sheet (Appendix C).

Additionally, the SMEs captured when the marker was observed to provide additional context and facilitate retrieval. Typically, when a behavior was noted during the AAR review, there was no need to record the audio channel, since the raw video file included both video and audio. However, while some AARs were recorded in a single cohesive video, others were recorded in multiple, usually three, short clips. When there were multiple video clips for one AAR, the researcher recorded on which clip the audio file occurred, using a simple numbering system to label clips: Clip 1, Clip 2, or Clip 3. The researcher included a time stamp and a key phrase in a process similar to one used to code behavior markers in the mission reviews. For example, to code the behavioral marker that occurred on June 17th during the AAR at three minutes into clip number two with a keyword "route," the researcher recorded "17 JUN, AAR, 3:00, Clip 2, route."

**Patterns of teamwork skills and collective efficacy (RQ2).** For RQ2, the researcher used the same process as was used for RQ1. The researcher collated the audio and video files, and the two SMEs completed the same behavioral marker frequency checklist as they reviewed the footage. When the SMEs observed a behavioral marker, they noted it on the data collection sheet. The SMEs discussed what they observed in the footage, coming to a consensus on whether they observed a behavioral marker before recording a final determination on their checklists. The consensus determination became the foundation of exploring teamwork skills that reflect collective efficacy.

**Patterns of taskwork performance (RQ3).** To explore the patterns of taskwork performance, the researcher compared the footage from the collated audio and video files to the PRMG developed for this study. The PRMG was inspired by the Tactical Decision-Making Analysis of Time and Accuracy, which was developed and refined over multiple research efforts (Cannon-Bowers & Salas, 1990; Johnston, 2005; Prince et al., 2008; Smith-Jentsch, Johnston, & Payne, 1998). More recently, behaviorally-anchored ratings scales have been utilized as a valid method of conducting field observations in the Army context (Phillips, Ross, et al., 2006; Phillips, Shafer, et al., 2006). The PRMG provided a valid and reliable method for the SMEs to evaluate team performance in the specific context under exploration. The PRMG was supplemented with the TCSS, a list of potential tasks that teams could conduct during the scenarios.

To be clear, the TCSS was not a measurement tool. It was utilized by the SMEs in order to keep track of what occurred during the scenarios. The TCSS was also utilized to facilitate consensus-driven discussions between the two SMEs when they initially disagreed on what score to rate the team. The PRMG set forth the guidelines for the subjective rating of team performance by the SMEs. The SME rating reflected how proficiently the teams executed their tasks in the tactical environment.

The three dependent variables of team cohesion, team efficacy, and team task performance were assessed for teams in both conditions (i.e., intervention and no intervention) in each of the two scenarios the teams performed. While examining the video and audio footage, the SMEs remained blind to the condition of the team participants conducting the two scenarios. However, since the SOF teams wore standard-issue equipment during the experiment, and the SMEs, being active-duty senior non-commissioned officers, could quickly and reliably identify the participants' unit type they were viewing, the SMEs were not blind to the unit type.

Using the PRMG (Appendix D) and TCSS (Appendix E), the SMEs reviewed the video and audio files to provide a performance score for the 21 teams who participated in this study. The study utilized a consensus model to ensure interrater reliability in the teams' performance scores. Both SMEs reviewed the audio and video files for all teams. The teams were scored independently by the SMEs using the PRMG (Appendix D). After individual scoring had been completed, the SMEs compared notes on performance and reached a consensus on subjective task performance ratings. The checklist (Appendix E) served as a guideline to facilitate discussions and consensus among the SMEs.

The data collection procedure resulted in a numerical score for each task a team conducted during the scenarios. The SMEs recorded at the top of the data collection sheet the scenario name (i.e., M2 or M3), the scenario date, the current date, and the SME's name. To code a task on data collection sheet, the SMEs also captured the task name (e.g., treat casualties and tactical movement), the team name, and the SME performance score. For example, the recorded code for a team that treated casualties in the scenario conducted on June 11th was "treat casualties, Squad 1–Alpha team, 4."

**Researcher Positionality**

This researcher is a pragmatist and believes there is value and truth in what is useful and effective. The researcher's professional position as a program manager for Army research at Northrop Grumman requires balancing the rigors of scientific inquiry with the realities of budget, timelines, stakeholders, and soldiers. In many cases, the researcher's work with the Army Research Institute for the Behavioral and Social Sciences culminates in a product (e.g., handbook, lesson plan, or digital application) delivered to a soldier or a high-level decision-maker in the U.S. Army, such as a senior-level officer. The researcher views the integration of solutions through science as an essential and necessary step in bridging the gap between theory and practice.

The researcher is practical in nature and not inclined to undertake a multi-year research effort only to identify problems; the researcher's preference is to present solutions or at least to offer a technique to mitigate problems rather than delegate the problem to soldiers. As a White male combat veteran, this researcher is familiar with the roles, duties, and responsibilities of team members in infantry squads. In fact, this researcher has held every position in an infantry fire-team at some point in his military career. Additionally, this researcher is a former member of a SOF unit. As such, there is potential for bias toward current members of SOF units who participated in the SOvM study.

The researcher did not have access to a list of participants by name. The soldiers were identified in the database by their squad, team, and position. For example, the database listed participant identification as “first squad, alpha team, rifleman.” The researcher did not recognize any of the participants in the videos. To be clear, the researcher did not know any of the participants. However, the researcher does have a professional relationship with one of the two SMEs; the researcher became acquainted with the SME during a separate study involving Army cyber warfare.

Built into this research design is a practical method to mitigate any unintended bias toward the SOF units during the course of this study. Utilizing two current active duty Army, senior non-commissioned officers as SMEs during the review of the video recordings and the audio files reduced opportunities for research bias. Moreover, having these two third-party experts come to a consensus on whether a behavior was exhibited strengthened the value of the findings and conclusions.

**Ensuring Trustworthiness and Rigor**

The researcher set conditions and implemented procedures to ensure the trustworthiness of the study’s findings. The researcher utilized established methods during data collection to ensure credibility. Issues of transferability were mitigated to the extent possible given the parameters of the study. The researcher employed a rigorous methodological approach to address issues of dependability and confirmability. The study’s credibility, transferability, dependability, and confirmability are addressed in additional detail in the following paragraphs.

**Credibility.** To ensure credibility, the researcher employed well-established qualitative methods and an experienced research team during the execution of this research. First, the researcher iteratively employed a review-revise procedure during protocol development. The SME-based review-revise procedure within the Army domain is documented in the literature (Phillips, Ross, et al., 2006; Phillips, Shafer, et al., 2006). Second, the researcher coordinated a two-hour training session with a senior scientist at ARL to indoctrinate the SMEs in the principles of sound data collection. During the training session, the ARL scientist described the best practices in data collection activities.

**Transferability.** Yin (2018) related the transferability in a qualitative study to the generalizability of that study's findings. One potential threat to transferability of the findings in this study is the convenience-based sampling technique used to select participants in the original SOvM study. There may be inherent differences in the teams assigned to the control and experimental group. Random chance could have led to more capable, higher-performing teams being assigned to one of the conditions. To mitigate the issue, the SOvM study team administered a thorough demographic questionnaire, which detailed the soldiers' experience level and training as well as a domain-knowledge questionnaire that tested their familiarity with the subject matter. Neither group exhibited an advantage in experience, training, or knowledge (SOvM study team, personal communication, November 16, 2017).

**Dependability.** The researcher addressed dependability with a thorough description of data collection tools and techniques. The researcher systematically reviewed the phenomenon under study. Included in the appendices are detailed data collection forms and checklists utilized by the researcher and the SMEs during data collection. The data collection forms clearly state the measures utilized and offer descriptions of representative tasks and scores. The scoring rubric for SME performance ratings provides examples of tasks as well as the criteria for recording a score between zero and six. The details and examples in the scoring rubric provide future researchers the requisite tools needed to replicate this study.

**Confirmability.** The researcher employed a robust methodological design to ensure confirmability. First, as discussed in the design section, utilizing an embedded design allowed the researcher to examine squads at their most fundamental level (i.e., Army teams). Exploring patterns of performance at the team level enhances the confirmability of squad findings. Second, the practice evaluation sessions both enhanced the fidelity of the data collection tools and ensured interrater reliability among the SMEs. The consensus model of SME ratings improved the confirmability of the study's findings.

**Data Analysis Techniques**

This section outlines the specific procedures used to record and analyze the data for each of the three research questions. For the dataset, no significant outliers were detected. The few instances where pieces of data were missing were confined to the demographics section, which was not salient to the examination of the research questions. For instance, the missing demographic data were primarily responses to the survey question regarding participants' total time in the Army. Four teams had no data recorded for this survey question. No statistical procedures were conducted on any of the demographic data, and the missing data did not affect the analysis in a meaningful way. The remainder of the section details the actions taken during analysis, categorized by research question. The techniques and processes the researcher utilized to analyze RQ1 and RQ2 are the same; therefore, to reduce repetition and improve readability, RQ1 and RQ2 analysis techniques are discussed jointly.

**Research Question 1 and Research Question 2.** To explore teamwork skills that reflect team cohesion and collective efficacy, the researcher used the abbreviated code discussed during the data collection process to retrieve the audio file. After retrieval, the researcher transcribed the audio file as close to verbatim as possible. However, the behaviors of interest frequently occurred during episodes of disorder. For example, early in the mission, the team is required to conduct observations on the village before proceeding by foot and conducting a key leader engagement.

For most teams, conducting the observation required very little communication. Thus no behavioral markers were recorded during this time for any team. Conversely, later in one of the scenarios, the team was confronted with enemy sniper fire resulting in wounded civilians and soldiers. The sniper fire created panic and chaos in the village. The instances of soldiers reacting to and engaging with the villagers and the enemy force produced a high frequency of behavioral markers.

The high frequency of behavioral markers during chaotic scenes occasionally prevented verbatim capture of the audio. In some instances, the soldier's audio was obscured by battlefield sounds (e.g., gunfire, enemy combatant, civilian villagers, and pyrotechnics). When the audio was obscured, the researcher checked other audio channels that occurred during the same timeframe. Typically, checking other audio channels improved the completeness of audio recording. In the few instances where audio was too distorted to collect verbatim, the researcher coded "*garbled*" in the analysis.

The researcher recorded the verbatim audio into an Excel© spreadsheet. After the audio was recorded in the excel spreadsheet, the researcher began analyzing the data for patterns. Yin (2018) noted an inductive pattern matching technique is useful when a study includes quantitative data. Yin (2018) identified that an inductive approach is particularly useful when analyzing behaviors within a context or when utilizing an embedded design: "quantitative data can surprisingly offer clues to the emergence of relevant or innovative concepts" (p. 169).

The researcher analyzed the verbatim audio files in three steps. First, the researcher grouped the audio communication by two topic codes: location and attitude. The locations were identified as either AAR or mission, and the attitudes were identified as either team cohesion or collective efficacy. Second, the researcher looked for patterns within the topics and further grouped communications by descriptive key words. For example, communications under the team cohesion topic that included expressions of taking initiative were categorized together, and communications under the collective efficacy topic that included expressions of task confidence were categorized together.

In total, the researcher discovered five descriptive categories for team cohesion and five descriptive categories for collective efficacy. The team cohesion categories are taking initiative, taking responsibility, seeking input, attitudes and affirmations, and contributing to problem solving. The collective efficacy categories are task confidence, cooperation, squad objectives, soldier assistance, and interpersonal tact. The researcher organized the soldier communication according to the descriptive categories.

Third, within the five descriptive categories, the researcher clustered the soldiers' audio communication into groups of positive and negative responses (Yin, 2015). The clustering technique allowed the researcher to organize the communications into subgroups (Yin, 2015). The context of the communication was particularly important during this step. Similar phrases could be categorized differently based on voice inflection or intonation. For example, the phrase "nice work" was not always a positive affirmation; occasionally it was uttered sarcastically. Similarly, screaming and explicative language was not always a negative. Soldier communication, especially during tense training missions can be contextual; gaining a clear understanding of the context was essential and occasionally required revisiting the audio and video files.

**Research Question 3.** The type of data collected determines the appropriate procedures to analyze the data. This study measured a scale-level dependent variable (i.e., performance scores); therefore, parametric as opposed to non-parametric analysis is appropriate. Before parametric analysis is conducted, the data must first be examined to determine if it is normally distributed. Figures 6 and 7 represent the respective normality curves of performance scores for M2 and M3. Both of these distributions conform to assumptions of normality.

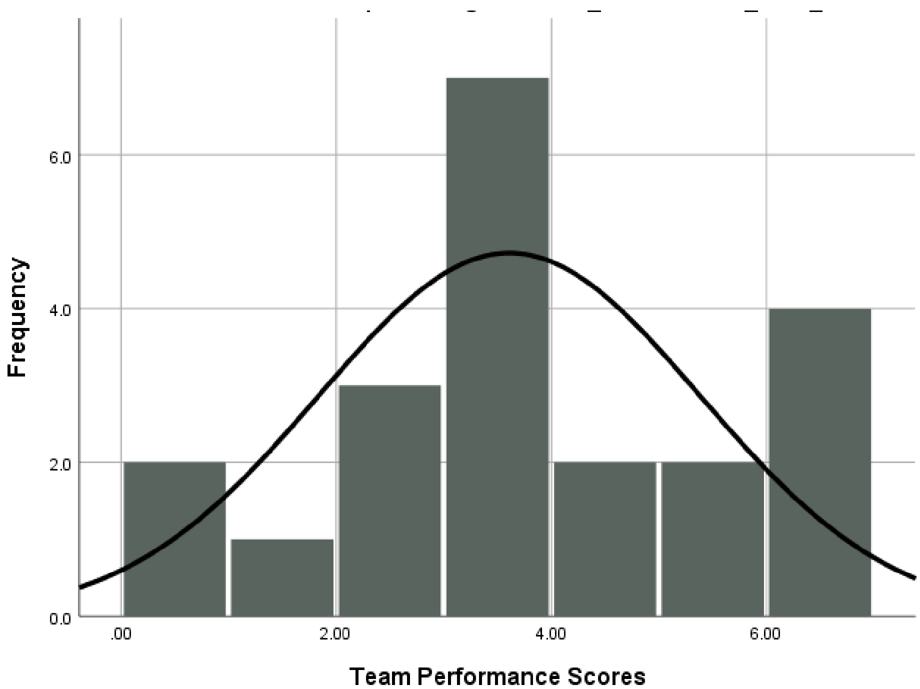


*Figure 6*. Histogram of team performance scores for M2.

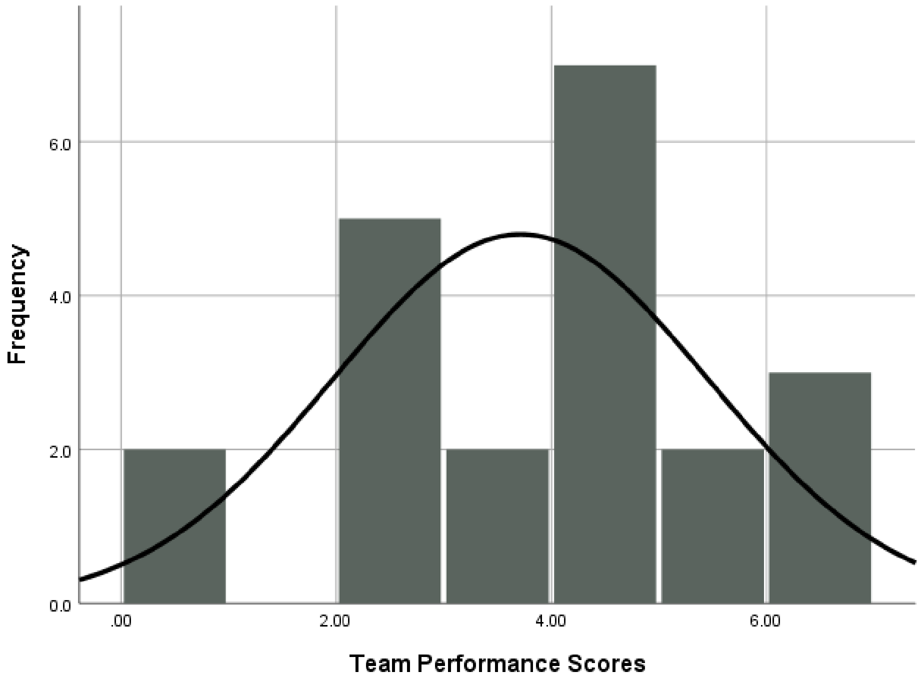


*Figure 7*. Histogram of team performance scores for M3.

Several assumptions are made concerning the data involved in the analysis for the embedded units in RQ3. The first assumption is that the dependent variable was measured continuously. The dependent variable for RQ3 is performance scores, which were measured continuously. The second assumption is that independent variables are categorical groups. For RQ3, both independent variables (i.e., unit and condition) are categorical (i.e., conventional or SOF, intervention or no intervention). The third assumption is that the groups should be independent with no team fitting into more than one group. As no team fits into more than one independent group, RQ3 meets this assumption. The fourth assumption is that there are no significant outliers. The dependent variable for RQ3 is performance scores measured on a seven-point scale; no significant outliers were recorded. The fifth assumption is that the dependent variable is normally distributed. The data shows that the performance scores for RQ3 approximate a normal distribution (Figures 6 and 7 in the preceding paragraph).

To explore patterns of taskwork performance outlined in RQ3, this researcher ran descriptive statistics in the software tool statistical package for the social sciences. The PRMG scores were averaged to produce a total team score. The data were entered into the statistical package for the social sciences, and the researcher ran descriptive statistics based on the performance scores from each scenario. There are two conditions (i.e., intervention and no intervention), two types of units (i.e., conventional and SOF), and two scenarios (i.e., M1 and M2). The descriptive statistics were an appropriate analysis technique because the researcher took multiple team measurements of the dependent variable.

**Chapter Summary**

Chapter 3 described the methodology and methods utilized to explore the phenomenon of interest. This study used a single-case, embedded-design approach on a 2016 dataset to explore the overarching research question. Because team cohesion and team efficacy, the elements of observation in this study, are inseparable from their context, a case study is appropriate to answer the research questions (Yin, 2018). Utilizing an embedded-design approach enabled data collection of the smaller subunits (i.e., the Army teams) before returning to the larger unit (i.e., the Army squad).

This chapter discussed the strengths and weakness of the research design and included a description of the database and sources of data. Case studies are more susceptible than other methods to shifts in design as data points are collected. The researcher addressed this potential weakness by employing a rigorous approach to the phenomenon under exploration. The strength of this design is its ability to utilize the rich, complete, and recent dataset from a large-scale live experiment to explore a real-world problem. The archival video and audio files in the database originated from Phase 2 of a 3-phase study aimed at improving the human dimension aspect of soldier performance.

Chapter 3 continued by outlining the research instruments, how those instruments were developed, and how the data were collected before discussing the techniques used during data analysis. The chapter discussed the development of the three research instruments, TCSS, BMMS, and PRMG, in detail. The chapter described the iterative instrument review process, along with how the instruments were accessed for validity. The researcher discussed how he organized and synched more than 60 hours of audio and video files to facilitate data collection with the two Army SMEs. The chapter concludes with an explanation of how the researcher coded individual and team communication into patterns and how the researcher ran descriptive statistics on the performance scores.

# Chapter 4: Data Analysis and Findings

To answer the overarching research question, this chapter is organized into the following five sections: (1) a description of the study's participants, (2) an explanation of how the data were prepared, (3) a presentation of the findings, (4) an analysis of the findings, and (5) a chapter summary. The description of the study's participants section provides their demographic information. The data explanation section explains how the data were prepared for analysis and how the analysis was conducted. The presentation of the findings section organizes the findings of the analysis and the research questions, discusses discrepant data, and simplifies information by averages in tables and figures. The analysis of findings section includes a synthesis of the results, again organized according to the research questions, and clearly articulates what the findings indicate.

The purpose of this qualitative case study was to explore taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States. The subsequent research questions are:

**RQ1:** What are the patterns of teamwork skills that are reflective of team cohesion?

**RQ2:** What are the patterns of teamwork skills that are reflective of collective efficacy?

**RQ3:** What are the patterns of taskwork performance between conventional and special operations U.S. Army combat squads?

Descriptive statistics producing performance averages are the appropriate analyses to apply to this dataset to answer the research questions (Yin, 2018). In this study, the dependent variable was team performance, and there were two independent variables, namely Army unit (i.e., conventional forces or SOF) and condition (i.e., intervention or no intervention). The researcher used descriptive statistics to develop an average performance score for each of the embedded units discussed above (Yin, 2018). The average performance scores facilitated a comparison between the different subunits while also examining the case from a holistic perspective (Yin, 2018).

**Description of Participants**

The researcher used survey data from the database to develop a description of the participants. The 64 soldiers whom the researcher utilized for this study had a minimum of one year in the Army, no more than seven and a half years in the Army, and an average of just over three years in the Army. Additionally, the soldiers had a minimum of half a year in their assigned unit, no more than seven years in their assigned unit, and an average of just over two years at their assigned unit. Finally, the soldiers had a minimum of one month in their current positions, no more than two years in their current positions, and an average of just over half a year's worth of experience in their current positions. Table 1 and Table 2 display the descriptive statistics of the participants as a whole and by team, respectively.

Table 1

*Soldier Demographics by Time (in Months) in Army, Unit, and Position for All Teams*

| | | Reported Team Times | | |
|---|---|---|---|---|
| Demographic | # of Teams | Min. Time | Max. Time | Avg. Time |
| Time in Army | 16 | 13.00 | 93.00 | 37.04 |
| Time in Unit | 21 | 7.25 | 86.00 | 27.37 |
| Time in Position | 21 | 1.00 | 24.00 | 8.06 |

*Note.* A total of 21 teams participated. Five teams were excluded from Time in Army because there was not enough data.

Table 2

*Soldier Demographics of Average Time (in Months) in Army, Unit, and Position by Team*

| Team | Army | Unit | Position |
|---|---|---|---|
| Team 1 | 36.00 | 15.30 | 3.30 |
| Team 2 | 49.30 | 31.00 | 8.00 |
| Team 3 | 30.00 | 51.00 | 1.00 |
| Team 4 | 28.00 | 14.30 | 9.00 |
| Team 5 | 29.50 | 15.70 | 9.00 |
| Team 6 | 93.00 | 86.00 | 18.50 |
| Team 7 | 26.00 | 15.70 | 7.00 |
| Team 8 | - | 24.30 | 5.30 |
| Team 9 | - | 57.00 | 6.50 |
| Team 10 | 16.00 | 13.50 | 4.50 |
| Team 11 | 13.50 | 7.30 | 6.50 |
| Team 12 | 55.50 | 22.00 | 8.00 |
| Team 13 | 13.00 | 10.30 | 6.00 |
| Team 14 | - | 30.50 | 8.00 |
| Team 15 | - | 36.00 | 3.00 |
| Team 16 | 49.00 | 22.70 | 6.00 |
| Team 17 | 29.70 | 25.70 | 5.30 |
| Team 18 | 51.50 | 50.00 | 24.00 |
| Team 19 | 28.33 | 15.00 | 8.75 |
| Team 20 | 44.33 | 8.75 | 5.67 |
| Team 21 | - | 23.00 | 16.00 |

*Note.* A total of 21 teams participated. Average time is indicated in months. Dashes indicate insufficient data reported.

**Presentation and Analysis of Findings**

This section presents the findings and their analysis. In what follows, the researcher discusses the findings relating to the three research questions. The section begins with of the patterns of teamwork skills enumerated through RQ1 and RQ2. The section follows with the analysis of performance related to RQ3. The findings are organized according to the research question to which they are relevant.

**Research Question 1.** To explore RQ1, this section will enumerate for each category of the behavioral markers the frequency observed by the SMEs and examples of soldier responses. This research study utilized 10 markers for cohesion: five positive markers and five negative markers for the corresponding adverse behaviors. Table 3 displays the markers organized by pattern and frequency. The remainder of the section will discuss the patterns of behavioral markers reflective of team cohesion.

Table 3

*Frequency of Team Cohesion Observations by Marker during M2 and M3*

| | | Observation Event | |
|---|---|---|---|
| Team Cohesion Marker | Total | AAR | Mission |
| Pattern 1 | | | |
| Soldiers actively work together and take initiative to reach squad objectives/goals | 33 | 0 | 33 |
| Soldiers do not actively work together or take initiative to reach squad objectives/goals | 2 | 0 | 2 |
| Pattern 2 | | | |
| Soldiers take responsibility for mistakes when they occur | 23 | 19 | 4 |
| Soldiers do not own up to mistakes when they occur | 6 | 4 | 2 |
| Pattern 3 | | | |
| Soldiers value squad member contributions during AARs/mission; seek input from the entire squad | 11 | 3 | 8 |
| Soldiers do not value member contributions during AARs/ mission; are dismissive of other squad member input | 6 | 0 | 6 |

(cont.)

Table 3. *Frequency of Team Cohesion Observations by Marker during M2 and M3* (cont.)

| Team Cohesion Marker | Total | Observation Event: AAR | Observation Event: Mission |
|---|---|---|---|
| Pattern 4 | | | |
| Soldiers make positive affirmations toward the squad's work | 14 | 1 | 13 |
| Soldiers make negative affirmations (e.g., "this sucks," "you suck," "why did you do that") toward the squad's work | 2 | 0 | 2 |
| Pattern 5 | | | |
| Soldiers contribute to discussions (TL to SL or SL to PL) about new courses of action/problem solving | 9 | 1 | 8 |
| Soldiers do not contribute to discussions (TL to SL or SL to PL) about new course of action/problem solving or were dismissive of soldiers who did | 0 | 0 | 0 |

*Note.* Markers are ordered by pair from highest to lowest frequency count. Team Leader (TL); Squad Leader (SL); Platoon Leader (PL).

***Team Cohesion Pattern 1: Taking initiative.*** The first cohesion marker "Soldiers actively work together and take initiative to reach squad objectives/goals" was among the most frequently observed positive behaviors that soldiers exhibited. Across all squads, there were 15 observations of "soldiers taking initiative" during the first scenario and 18 observations during the second scenario. In total, there were 33 observations of this behavioral marker. The two instances of the negative marker ("Soldiers do not actively work together or take initiative to reach squad objectives/goals") bring the total to 35 cumulative observations. Examples of positive soldier communication in the pattern "Taking initiative" include:

- Squad 3: "I heard where it [gunshot] came from. I can crawl over to you and show you where it came from."

- Squad 3: [speaking to the medic] "What are you working on now? Is there anything I can do to help you?"
- Squad 3: "Have you checked [his] back for exit wounds? We could wrap up his head to help stabilize it."
- Squad 3: "Do you want me to cover this big open area here? Alright, we got you covered bro."
- Squad 2: "How are you doing? Still breathing? Alright, let me know if you're hurting [name redacted]."

An example of negative soldier communication in this pattern is:

- Squad 1: "F**k dude! Tell us [when] you're moving! That needs to be confirmed!"

***Team Cohesion Pattern 2: Taking responsibility.*** The second cohesion marker "Soldiers take responsibility for mistakes when they occur" was the second-most frequently observed positive behavior that soldiers exhibited. Across all squads, there were 18 observations of "taking responsibility" during the first scenario and five observations during the second scenario. In total, there were 23 observations of the positive version of this behavioral marker. The six instances of the negative marker "Soldiers do not own up to mistakes when they occur" bring the total to 29 cumulative observations. Examples of positive soldier communication in the pattern "Taking responsibility" include:

- Squad 6: "I told him to go there. That one is on me."
- Squad 3: "He's dead right? No?! Alright. Sh**t. Sorry."
- Squad 1: "I should have maneuvered around the backside instead of moving through the center of town."

An example of negative soldier communication in this pattern is:

- Squad 1: "I thought you said this is Alpha-one! This is not A1. I didn't say it was."

***Team Cohesion Pattern 3: Seeking input.*** The third pair of cohesion markers "Soldiers value squad member contributions during AARs/mission; seek input from the entire squad" and "Soldiers do not value member contributions during AARs/mission; are dismissive of other squad member input" were moderately observed soldier behaviors. Across all squads, there were four observations of "seeking input" during the first scenario and seven observations during the second scenario. For the negative behavior, there were four observations during the first scenario and two during the second scenario. In total, there were 17 cumulative observations. Examples of positive soldier communication in the pattern "Seeking input" include:

- Squad 6: "What do you think? We could move to this divot [pointing to an area near the woods outside of the village]. It will provide cover"
- Squad 5: "Talk to me. What do you got? I have a set of windows over here. Roger, good eyes good eyes."

An example of negative soldier communication in this pattern is:

- Squad 5: "That makes no sense. He told me to go over there then you to go over there"

***Team Cohesion Pattern 4: Attitudes and affirmations.*** The fourth pair of cohesion markers "Soldiers make positive affirmations toward the squad's work" and "Soldiers make negative affirmations (e.g., 'This sucks,' 'You suck,' or 'Why did you do that?') toward the squad's work" were a moderately observed soldier behavior. Across all squads, there were six observations of "positive affirmations and attitudes" during the first scenario and eight observations during the second scenario. For the negative, there was a single observation in each scenario. In total, there were 14 observations of the positive version of this behavioral marker.

The two instances of the negative marker bring the total to 16 cumulative observations of this pattern. Examples of positive soldier communication in the pattern “Attitudes and affirmations” include:

- Squad 6: “[After successfully suppressing the enemy force] That was sexy. Yeah man, that was sexy as f**k
- Squad 6: “[After stabilizing a wounded non-combatant] Good sh** working through that bro”

Examples of negative soldier communication in this pattern include:

- Squad 5: “Hey! Slow it down! THINK about what you're doing!”
- Squad 4: “You gotta put on a chest seal first dumb**s!”

***Team Cohesion Pattern 5: Contributing to problem solving*.** The final pair of cohesion markers “Soldiers contribute to discussions (TL to SL or SL to PL) about new courses of action/problem solving” and “Soldiers do not contribute to discussions (TL to SL or SL to PL) about new course of action/problem solving or were dismissive of soldiers who did” were exhibited less frequently than most of the other patterns of cohesion. The negative communication pattern (i.e., did not contribute) was the only one that was not exhibited by any of the squads in either scenario. Across all squads, there were three observations of “contributing to problem solving” during the first scenario and six observations during the second scenario. In total, there were nine observations of the positive version of this behavioral marker, and as mentioned, there were zero observation of the negative marker. Examples of positive soldier communication in the pattern “Contributing to problem solving” include:

- Squad 4: “Should we get into the building? The building will provide us some hardcover.”

- Squad 1: “We can set up a base of fire—fire and maneuver from right there and hit the house.”

**Research Question 2.** To explore RQ2, this section will enumerate for each category of the behavioral markers the frequency observed by the SMEs and examples of soldier responses. This research study utilized 10 markers for efficacy: five positive markers and five negative markers for the corresponding adverse behaviors. Table 4 depicts the markers organized by pattern and frequency. The remainder of the section will discuss the patterns of behavioral markers reflective of collective efficacy.

Table 4

*Frequency of Collective Efficacy Observations by Marker during M2 and M3*

| | | Observation Event | |
|---|---|---|---|
| Collective Efficacy Marker | Total | AAR | Mission |
| Pattern 1 | | | |
| Soldiers express confidence in squad task completion | 11 | 0 | 11 |
| Soldiers express doubt or fear of failure regarding squad task completion | 11 | 1 | 10 |
| Pattern 2 | | | |
| Soldiers cooperate and avoid unproductive conflict regarding task completion | 7 | 1 | 6 |
| Soldiers do not cooperate and engage in unproductive conflict regarding task completion | 10 | 0 | 10 |
| Pattern 3 | | | |
| Soldiers express confidence regarding conflict resolution and squad priorities and/or objectives (e.g., “Let’s do this!") | 3 | 0 | 3 |
| Soldiers express doubt regarding conflict resolution and squad priorities and/or objectives (e.g.," Let's just get this over with") | 3 | 0 | 3 |

(cont.)

Table 4. *Frequency of Collective Efficacy Observations by Marker during M2 and M3* (cont.)

| Collective Efficacy Marker | Total | Observation Event | |
|---|---|---|---|
| | | AAR | Mission |
| Pattern 4 | | | |
| Soldiers rely on squad members for assistance | 4 | 0 | 4 |
| Soldiers rely on non-squad members (i.e., third party) for assistance | 1 | 0 | 1 |
| Pattern 5 | | | |
| Soldiers manage interpersonal tact while communicating squad priorities and/or objectives | 1 | 0 | 1 |
| Soldiers do not manage interpersonal tact while communicating squad priorities and/or objectives | 2 | 0 | 2 |

*Note.* Markers are ordered by pair from highest to lowest frequency count.

***Collective Efficacy Pattern 1: Task confidence.*** The first pair of efficacy markers "Soldiers express confidence in squad task completion" and "Soldiers express doubt or fear of failure regarding squad task completion" were a moderately observed soldier behavior. Across all squads there were three observations of task confidence during the first scenario and seven observations during the second scenario. For the negative behavior, there were nine observations during the first scenario and two in the second. In total, there were 21 observations of this pattern. Examples of positive soldier communication in the pattern "Task confidence" include:

- Squad 6: "I'm going to cover you. You're going to pop out and get that door."
- Squad 5: "That's a sniper hole right there. Are you sure? Yeah"
- Squad 3: "They're [enemy force] south of here. Well blow them away. I will."
- Squad 2: "You gotta watch the right one *alleyway* for me. I'm watching the windows for you."

Examples of negative soldier communication in this pattern include:

- Squad 2: "[TML to rifleman] I have no idea why we went down the middle of the road"
- Squad 2: "I thought it was really dumb moving to somebody. Why would you go to the building and clear the building when you could just come to this one?"
- Squad 4: "I'm in a terrible spot. I need to move before he shoots us both. Sergeant! I'm way exposed out here."
- Squad 4: "Watch for IEDs—don't want you to take me out with you"

***Collective Efficacy Pattern 2: Cooperation.*** The second pair of efficacy markers "Soldiers cooperate and avoid unproductive conflict regarding task completion" and "Soldiers do not cooperate and engage in unproductive conflict regarding task completion" were a moderately observed soldier behavior. Across all squads there were three observations of cooperation during the first scenario and four observations during the second scenario. For the negative behavior, there were five observations during each of the scenarios. In total, there were 17 cumulative observations. An example of positive soldier communication in the pattern "Cooperation" is:

- Squad 3: "Hey [I hear] sporadic gunfire from that building over there. Well s**t let's go clear it!"

Examples of negative soldier communication in this pattern include:

- Squad 4: "Keep your head on a swivel. That's what I'm doing dude."
- Squad 4: "How come you weren't controlling them? I WAS controlling them!"

***Collective Efficacy Pattern 3: Squad objectives.*** The third pair of efficacy markers "Soldiers express confidence regarding conflict resolution and squad priorities and/or objectives (e.g., Let's do this!)" and "Soldiers express doubt regarding conflict resolution and squad priorities and/or objectives (e.g., Let's just get this over with)" were an unfrequently observed soldier behavior. Across all squads there were zero observations of squad objectives during the first scenario and three observations during the second scenario. For the negative behavior, there were two observations during the first scenario and one during the second. In total, there were six cumulative observations. An example of positive soldier communication in the pattern "Squad objectives" is:

- Squad 3: "We're gonna go kill those guys [referring to enemy forces]. We'll be right back."

An example of negative soldier communication in this pattern is:

- Squad 4: "I'm exposed out here SGT. Obviously he [team leader] doesn't give a s**t that you're exposed."

***Collective Efficacy Pattern 4: Soldier assistance.*** The fourth pair of efficacy markers "Soldiers rely on squad members for assistance" and "Soldiers rely on non-squad members (i.e., third party) for assistance" were among the least frequently observed behavior that soldiers exhibited. Across all squads there were two observations of soldier assistance during the first scenario and two observations during the second scenario. For the negative behavior, there were zero observations during the first scenario and one in the second. In total, there were five cumulative observations. An example of positive soldier communication in the pattern "Soldier assistance" is:

- Squad 5: "Do you need help? Are you good? Doc grab who you need, there is one chest wound in there."

An example of negative soldier communication in this pattern is:

- Squad 5: "[Soldier telling a teammate not to render aid to the wounded] Hey pull out of this; you're not a doctor."

***Collective Efficacy Pattern 5: Interpersonal tact.*** The final pair of efficacy markers "Soldiers manage interpersonal tact while communicating squad priorities and/or objectives" and "Soldiers do not manage interpersonal tact while communicating squad priorities and/or objectives" were an unfrequently observed soldier behavior. Across all squads there was one observation of interpersonal tact during the first scenario and zero observations during the second scenario. For the negative behavior, there was a single observation during each of the scenarios. In total, there were three cumulative observations. An example of positive soldier communication in the pattern "Interpersonal tact" is:

- Squad 5: "Stop. Ground yourself. I need you to take [name redacted] and go get [redacted name of wounded soldier] and bring him back here."

Examples of negative soldier communication in this pattern include:

- Squad 4: "You literally just told me to push past. That mother f***er."
- Squad 1: "Don't move to f***ing fast! This is f***ing bulls**t."

**Research Question 3.** To explore RQ3, this section will examine the performance of Army teams as an embedded subunit of the Army squad. Given the complexity symptomatic of teamwork and team-performance interactions in dynamic environments, it is instructive to specify the variables. The independent categorical variables are unit type (i.e., conventional or SOF) and condition type (i.e., intervention or no intervention); the dependent variable is team performance. The researcher ran descriptive statistics on all relevant dependent and independent variables for scenarios M2 and M3; Table 5 displays the results.

Table 5

*Average Task Performance Score Ratings for Teams in Each Condition and Each Scenario*

| Condition | Conventional | | SOF | | Overall | |
|---|---|---|---|---|---|---|
| | Avg. | # of Teams | Avg. | # of Teams | Avg. | # of Teams |
| Scenario M2 | | | | | | |
| No Intervention | 1.72 | 6 | 4.41 | 6 | 3.07 | 12 |
| Intervention | 3.50 | 6 | 6.00 | 3 | 4.33 | 9 |
| Total | 2.61 | 12 | 4.94 | 9 | 3.61 | 21 |
| Scenario M3 | | | | | | |
| No Intervention | 2.54 | 6 | 4.02 | 6 | 3.28 | 12 |
| Intervention | 3.44 | 6 | 6.00 | 3 | 4.29 | 9 |
| Total | 2.99 | 12 | 4.68 | 9 | 3.71 | 21 |

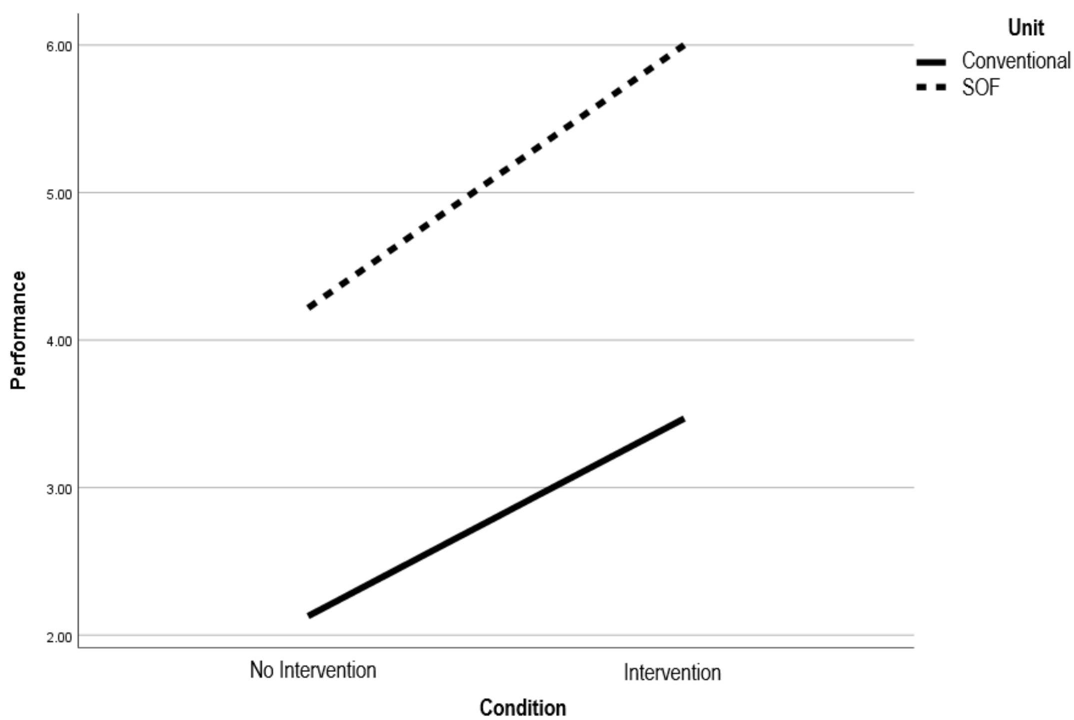


*Figure 8*. Estimated marginal average performance by condition and unit type.

The lowest scoring teams throughout the two scenarios were the six teams in the conventional–no intervention group, while the highest performing teams throughout the two scenarios were the SOF teams in the intervention group. The gap in performance between the best and worst performing teams is not surprising, as the SOF teams were expected to outperform conventional teams in tactical scenarios. On closer examination, it is telling that a teamwork skills intervention was able to improve performance among SOF team members, given the level of training they had to complete to be assigned SOF. Additionally, the fact that the conventional forces exhibited a similar increase in performance speaks to both a lack of teamwork skill development in Army training across units as well as to the generalizability of improving teamwork skills to Army combat teams.

**Analysis.** An analysis of the data collected from RQ1 indicates three underlying implications. First, the patterns of team cohesion were primarily based on positive observations. There were 90 recorded observations of positive instances of behavioral markers compared to only 16 negative instances. Second, team cohesion markers were predominately mission-based. There were 78 observations recorded during the mission compared to only 28 observations during the AAR. Third, the team cohesion markers were twice as prevalent as the collective efficacy markers.

Similarly, an analysis of the data collected from RQ2 indicates two underlying implications. The collective efficacy markers were more evenly distributed than the cohesion markers. There was a total of 26 positive observations and 27 negative observations recorded. Like the team cohesion markers, collective efficacy markers were also predominately mission-based. Fifty-one of the observations were recorded during the mission to only two observations during the AAR.

Across all 20 behavioral markers, 129 were recorded during the mission, compared to only 30 during the AAR. The increase of the record of observations during the mission is likely due to the active versus passive nature of the two situations. During a mission, soldiers interact with one another frequently and in smaller elements (U.S. Department of the Army, 2012). For instance, riflemen often convey information at the same time as the squad leader and team leader do. While soldiers actively participate in a mission as they shoot, move, and communicate, their behavior in an AAR is more passive (Reitz & Seavey, 2016; U.S. Department of the Army, 2017a). An effective AAR will include a great deal of participation from the soldiers; however, they are primarily receiving guidance from Army leadership (Laurence & Matthews, 2012). Given the difference between action-oriented and reception-oriented participation, the increased observations during the mission are not surprising.

An analysis of the data collected from RQ3 shows a distinct pattern of performance both between and among conventional and SOF combat squads: The SOF squads, on average, outperformed the conventional squads during the training mission; yet both SOF and conventional squads improved after exposure to teamwork skills training. This salient finding suggests that Army squads, across unit types, lack specific teamwork skills and that combat squads in general would benefit from teamwork-driven training.

**Trustworthiness of the data.** One potential issue with the trustworthiness of the data for RQ1 and RQ2 comes from the method of pattern matching (Yin, 2018). The research team utilized a consensus approach from SMEs to determine which behavioral marker fit for each soldier communication observed. Ultimately, the SMEs did reach consensus before a behavior was recorded. However, there were certainly instances in which communications were open to interpretation and could have been categorized differently (Yin, 2018).

As an example, an argument between soldiers from Squad 1 included the following back-and-forth communication: “I thought you said this is Alpha-one! This is not A1. I didn’t say it was." The research team coded this as "Soldiers do not own up to mistakes when they occur." However, a reasonable person could have coded it as a different pattern, such as "Soldiers do not cooperate and engage in unproductive conflict regarding task completion." This is one such example of many exchanges between soldiers where the SMEs used their contextual expertise and knowledge of the scenario to come to a consensus. Another set of SMEs may have interpreted similar exchanges differently, which may have affected the findings.

From the quantitative perspective of the embedded unit design, the primary reliability issue in this study is the relatively small sample size (Creswell, 2014; Yin, 2018). Although 64 individual soldiers participated in this study, the total sample size is reduced to 21 because the soldiers formed teams. There are inherent limitations with a small sample size, which can result in sampling errors (Creswell, 2014). As such, the results should be replicated with a larger sample size in future quantitative studies.

According to the initial plan, eight squads (i.e., 24 teams) were to have participated in the study; however, three of the SOF unit teams pulled out of the experiment, leaving only 21 teams (J. H. Johnston, personal communication, February 25, 2019). During the first three teams' participation in the scenario, a technological glitch occurred, resulting in no video data of the team AAR. This missing data posed a problem for answering RQ1 and RQ2 in terms of the patterns of teamwork skills, since the researcher did not have sufficient data to include these three teams in the analysis of either team cohesion or collective efficacy. However, no such problem existed for answering RQ3. All of the mission scenario data for these three teams were intact and were included in the taskwork performance analysis. As mentioned in Chapter 1, there was one squad who did not participate in the experiment group; therefore, none of this squad's three teams was included in the analysis. As such, the performance analysis included two instances of 21 teams (i.e., seven squads), but the behavioral marker analysis, which was conducted at the squad level, included only 18 teams (i.e., six squads).

Another potential issue with the reliability and validity of this study is the inherent dynamics of multilevel teams (Kozlowski, 2015). For example, U.S. Army teams operate in a hierarchy. Individual soldiers are nested within teams, which are nested within squads, which are nested within platoons (Mundweil, 2013). This pattern continues at higher levels, culminating in an Army Division of approximately 15,000 soldiers or a Corps of approximately 40,000 soldiers (U.S. Department of the Army, 2014). In this multilevel system, higher-level commands influence subordinate units, by, for instance, determining which tasks and therefore which choices members in a subordinate unit might make. The participants in this study formed part of a multilevel system, in that squad leaders decided which teams performed which tasks.

Over the course of the study, the research team observed a variety of distribution styles among the squad leaders: Some squad leaders divided tasks approximately equally between teams, some delegated most of the tasks to a single team, and some failed to delegate tasks. In the last instance—the failure to delegate tasks–a squad leader either executed the majority of the tasks himself or led an ad hoc team in executing the tasks. It is important to note, however, that the uneven distribution of tasks is not necessarily indicative of poor tactical decision-making (Hedlund, 2017; Hoch & Kozlowski, 2014). An experienced squad leader with an inexperienced team leader may purposefully choose to delegate tasks unevenly, assigning a heavier task load to the more experienced soldiers; conversely, a squad leader who lacks trust in his subordinate leaders can unjustly micromanage them.

The research team observed a variety of delegation choices made by the squad leaders, but similar choices did not always result in similar outcomes. The result of the multilevel system of task assignment in this study is that some teams had only one or two tasks assigned to them, while other teams had as many as 10. The more tasks a team was evaluated, the more robust the performance score, and the more confident this researcher is that the score approximates reality. To compound this issue of uneven task assignment, the tasks varied in difficulty. For instance, the task of establishing an observation post was relatively easy, and teams who were assigned this task typically scored high. Conversely, other tasks, such as entering and clearing a building, were more challenging; performance results for these tasks ranged across the entire score spectrum of zero to six points. In summary, some scores of team task performance were more robust than others, either because they were derived from observations of more difficult tasks or because they were derived from a larger number of observations.

Another factor that may contribute to trustworthiness issues is the intervention itself. The intervention was primarily focused on improving and developing teamwork skills. However, by including TC3 training, a medical-based trauma training designed to teach soldiers to provide self-aid and buddy-aid when wounded, the intervention introduced more than one possible cause for improvements in performance. It is possible, albeit unlikely, that the TC3 training was responsible for the results of this study; alternatively, is it possible that the interaction between the TC3 and teamwork skills training produced the increase in team task performance.

**Confirmations or contradictions of the conceptual framework.** As suggested in the recent literature (Sottilare et al., 2017) and in the conceptual framework, findings from this study suggest that team cohesion and collective efficacy are antecedents to team performance. Additionally, findings from this study could inform the modification of other theoretical models. For example, the TKE has not been tested empirically with field research in an Army context (Grand et al., 2016). This study suggests that affective-domain team-level concepts may mediate the sharing of information. Thus the TKE model, which depicts sharing (i.e., communication) as a core construct of team knowledge emergence (Grand et al., 2016), could be improved by revising its communication elements to include the affective-domain element of team cohesion as a mediator of communication. In this regard, team cohesion may impact communication between team members and thereby influence team knowledge emergence. Future studies may look to confirm attitudinal contributors not included in this study, such as trust. Furthermore, there remains a potential for studies attempting to amplify or mediate the effects of teamwork skills such as coordination or leadership.

**Chapter Summary**

Chapter 4 began with a description of the study's participants and an explanation of how the data were analyzed. The demographics of the study's participants were described in narrative form, then detailed in two tables with descriptive statistics. The first table depicted for each soldier in the study (1) the average time in the Army, (2) the average time in the unit, and (3) the position in the team. The second table displayed these demographics aggregated by team. Following the demographic section was a comprehensive summary of the process used to analyze the data.

Chapter 4 continued by thoroughly describing the findings by research question. Findings from RQ1 began with a table that contained a frequency count of team cohesion observations. The researcher presented each of the team cohesion patterns from highest to lowest occurrence, providing examples of soldier communication reflective of the pattern. Similarly, findings from RQ2 began with a table of collective efficacy observations and continued with examples of soldier communication. Findings from RQ3 began with a table of descriptive statistics of the task performance scores for the conventional and the SOF teams.

Chapter 4 concluded with a description of what the findings mean within the context of Army squads. The researcher offered an analysis of the patterns of teamwork skills that reflect team cohesion and collective efficacy. As noted, most of the markers were recorded during the mission. The analysis graphically depicts the gap in performance scores between Army teams with prior teamwork skills training and teams without prior teamwork skills training. The analysis suggests that patterns of behaviors during training situations can be measured with behavioral markers and that training in teamwork skills improve performance in Army squads. Chapter 5 will explore these topics in more detail.

# Chapter 5: Summary, Conclusions, Implications, and Suggestions for Future Research

The concluding chapter of this study is organized into seven sections: summary of the major findings, conclusions, interpretation of the findings, implications, suggestions for future research, limitations and reflexivity, and a chapter summary. The summary of major findings section is akin to an executive summary and concisely details the entire study. The conclusion offers a critical reflection on the analysis and the study's findings as well as a summary of the findings. The interpretation of findings section is a subjective discussion of the study's findings in the larger context of applied research. The implications section describes the relationship of this study to other recent relevant literature. The suggestions for future research section describes future research topics and issues based on questions that emerged from this study. The limitations and reflexivity section addresses the limitations in this study due to flaws in implementation and highlights which approaches worked well and which did not. The chapter summary section provides a brief synthesis and offers the researcher's final comments.

## Summary and Major Findings

Modern warfare is complex and dynamic; Army teams need to be agile in order to adapt to rapid changes in the various battlefield environments. To complete their missions, Army soldiers employ both taskwork skills and teamwork skills. While the Army has effective measures with which to gauge procedural taskwork, it does not comprehensively assess teamwork (U.S. Department of the Army, 2017a). When soldier teamwork is assessed, it is done by third-party research organizations who primarily use self-report measures. Self-reporting is limited by its subjective nature and can provide data too vague or inaccurate to adequately assess teamwork skills (Donaldson & Grant-Vallone, 2002; Kozlowski, 2015). Teamwork skills are critical to team performance (DeChurch & Mesmer-Magnus, 2010); a lack of teamwork skill development can result in suboptimal performance of soldiers in combat situations. Currently, soldier teamwork skills are not systematically assessed in field environments, though measures of teamwork skills are available in the literature (Kozlowski, 2015; Sottilare et al., 2017), nor are teamwork skills included in team debriefs (Townsend et al., 2018). Furthermore, the teamwork measures that are available are static and ill-equipped to identify teamwork skills as they emerge in field environments (Kozlowski et al., 2016).

The purpose of this qualitative case study was to explore teamwork skills of selected combat solders in training situations in the Southeastern United States. By exploring the patterns of teamwork skills that are reflective of team cohesion and collective efficacy, as well as the pattern of teamwork performance, this study attempts to address the gap in the use of teamwork performance measures for Army teams. This study used a single-case, embedded-design approach on a 2016 dataset. The purpose of this study led to the development of the overarching research question: What are the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States? From this question, the following topic-related research sub-questions were developed:

**RQ1:** What are the patterns of teamwork skills that are reflective of team cohesion?

**RQ2:** What are the patterns of teamwork skills that are reflective of collective efficacy?

**RQ3:** What are the patterns of taskwork performance between conventional and special operations U.S. Army combat squads?

The topical literature review resulted in three major findings: First, teamwork skills training has demonstrated improvement of performance outcomes (George & Quatrara, 2018; Riojas & Austin, 2017) and has shown resilience to degradation over time (George & Quatrara, 2018; Hoang et al., 2016; Reinemann et al., 2015); pertinent to Army combat soldiers, teamwork skills improve performance outcomes in dynamic and austere environments (Riojas & Austin, 2017; Valdiri et al., 2015). Second, information-sharing among team members can differ by its quality, quantity, and category in each of these elements. Any differences between team members can complicate the connection between communication and team performance (Brewer & Holmes, 2016; Marlow et al., 2018; Song et al., 2015). For instance, oversharing low-quality information will detract from team performance because the recipients must distinguish trivial from meaningful information before communication can take place (Ellwart et al., 2015; Gardner et al., 2012). Third, individual team members interact both within and between multiple levels (i.e., team, squad, and unit), creating an intricate bundle of task performance and mission communication that is difficult to untangle (Cooke, 2015; Fiscella et al., 2017; Haar et al., 2015).

Using a conceptual framework based on Sottilare et al. (2017) linking team performance to team cohesion, collective efficacy, and communication, the researcher explored a rich database of Army combat teams for patterns of both taskwork performance and teamwork skills. The researcher employed two different methods: pattern-matching methods were used to enumerate behavioral markers at the squad level, and quantitative methods were used to examine embedded Army subunits (Yin, 2018). The study found meaningful performance differences between the groups who were exposed to the training intervention: For both conventional and SOF units, teamwork skills intervention improved Army team performance. This result suggests that Army combat teams, while often cohesive, lack the teamwork skills needed to optimize performance. Furthermore, the study's findings suggest that an improvement in tactical performance is possible with deliberate training in teamwork skills.

**Conclusions**

The conclusions of this study are as follows:

1. Patterns of teamwork skills that are reflective of team cohesion and collective efficacy can be measured during training situations with behavioral markers.
2. Behavioral markers are an effective but resource-intensive means of augmenting self-reports with objective measures during training situations for Army combat squads.
3. Team cohesion and collective efficacy are antecedents of performance in Army combat teams.

Conclusion 1: Findings from this study support other recent research that suggests team cohesion and collective efficacy are two of the most important elements of team performance (Kozlowski & Chao, 2012; Salas et al., 2015; Sottilare et al., 2017). As a whole, however, the research community has few options aside from Likert scores for measuring these important team attributes. It is well known and documented in the research literature that Likert scores are subject to potential biases (Donaldson & Grant-Vallone, 2002; Kozlowski, 2015). This study demonstrated that patterns of teamwork skills that are reflective of team cohesion and collective efficacy can effectively be measured in training situations with behavioral markers.

This research shows promise regarding future measurement tools for team performance studies. Though the behavioral markers used in this study were tailored by the research team and so may not extend well to other populations, these markers can be utilized by the Army within its combat specialties for more objective measurements. More objective and therefore more accurate measures of teamwork skills will improve the Army's understanding of the effects of educational and training interventions on combat squads.

Conclusion 2: Though behavioral markers are more time-consuming to record, they appear to produce a more accurate representation of critical team attributes, particularly in field settings. Currently, artificial intelligence is not sophisticated enough to capture these attributes automatically; they must be collected by trained observers, creating an increase in both the lead time for training the observers as well as the labor cost of data collection. However, researchers investigating team dynamics should be cautious of putting too much trust in Likert scores without properly controlling for the inherent protocol limitations and cognitive biases. They should therefore consider the resources as well as the costs involved in utilizing behavioral markers.

Conclusion 3: The fact that the intervention of teamwork skills training improved the performances of both the SOF and the conventional forces indicates that this intervention is fundamental, albeit lacking, to team performance across both unit types and training methodologies. The lack of interaction between the two groups (i.e., intervention and no intervention) in the data suggests that teamwork skills are fundamental antecedents to performance. Additionally, the data suggest that this fundamental skill is insufficiently trained at the team level across unit types. These findings are encouraging for the generalizability of conclusions in this study across unit types.

**Interpretation of Findings**

This section builds on the conclusions above and situates them in the context of this study's objectives. This section revisits the literature discussed in Chapters 1 and 2. The researcher provides interpretations of the study's data within the broader context of team performance. The section is organized by research question and provides a more subjective interpretation than what was offered in the summary of findings.

**Interpretation 1: Teamwork skills improve performance in Army combat teams.** Asserting that teamwork skills improve performance in Army teams may strike the reader as an obvious observation. Elements of this interpretation are intuitive: Few environments are as dangerous, dynamic, and austere as those in which the infantry operate (i.e., ground combat). It stands to reason that teamwork skills would be a crucial part of Army training, yet little has been done within the Army to systematically develop, assess, or reinforce teamwork skills. The U.S. Army is highly regarded for its team-building, and broadly speaking, Army teams are extremely cohesive and effective units; however, there are few teams that would not benefit from additional, purposeful training in teamwork skills, specifically in communication. Even U.S. Special Operations teams exhibited improved performance after exposure to teamwork skills training, as demonstrated in Figure 8 in the presentation of findings section.

**Interpretation 2: Army AARs can be improved.** Army squads conduct AARs after each training exercise or live mission. These standard performance reviews are encoded into the culture of Army units down to the squad level. The ways in which Army squads conduct debriefs affect the squads' future tactical performances. Current Army squad debriefs focus primarily on taskwork skills. Taskwork skills are point-of-execution skills and as such are a crucial, action-oriented aspect of team performance.

Army squads should continue to discuss elements of taskwork during debriefs; however, including teamwork skills would improve Army squad debriefs. Based on the findings of this study, modifying AARs to include discussions of communication as a vital teamwork skill could radically improve performance in tactical scenarios. Addressing communication—specifically, who should communicate what information and when that communication should occur—would help create a shared mental model within which individuals could contextualize their own efforts toward mission success. While some training may be necessary, implementing a new AAR format that includes a focus on what information to communicate and how often to communicate it would cause little disruption. Even if the gains were modest, the costs of implementation are low to negligible. Implementation should be considered, given that readiness is the Army's first priority (Berglund & Filiberti, 2017).

**Interpretation 3: Teamwork skill interventions should be aggressively pursued.** The U.S. military has seen a number of combat operations over the past decades, yet combat deaths caused by the enemy are concentrated in one type of soldier, the infantryman (Scales, 2016). Not since 1953 in the Korean War has a tank crew member been killed by an enemy tank; not since 1945 in WII has a submarine been sunk, and not since 1972 in Vietnam have bomber crewmen died from enemy fire (Scales, 2016). Conversely, in WWII alone, a stunning 70% of combat fatalities were in the infantry and the ratio is even worse today, with the infantry suffering 89% of combat fatalities in Afghanistan. This burden of combat death is shouldered by a disproportionately small percentage of uniformed military personnel, as the infantry makes up less than 4% of the total force (Scales, 2016). All other mechanized elements of the Army have leveraged technology and training to create overmatch. It is thus overwhelmingly the infantry who fight and die in close combat. Any training intervention that can be readily deployed and integrated into current training cycles to improve soldier performance in tactical scenarios should be pursued aggressively.

## Implications

This section frames the findings of this study based on the implications for literature, policy, and professional practice. The challenges discussed in Chapters 1 and 2 are readdressed in light of the findings from this study's data. This section is organized by topic and discusses how these findings add to the collective body of knowledge and practice.

**Implications for literature.** The findings of this study address issues in the existing scholarly literature regarding the bias and unreliability of self-report measures. Donaldson and Grant-Vallone (2002) noted that self-report measures are subject to biases that result in positive attributes being over-reported and negative attributes being under-reported, and Prince et al. (2008) found only a weak correlation between self-report measures and direct observations. Additionally, self-report data are known to be subject to validity issues, as the participant may not understand a question in the way the researcher intended. This study sets a foundation to address this issue by providing patterns of teamwork skills and examples of behavioral markers. When used to augment self-reports, these behavioral markers can improve their reliability.

Recent research indicates a lack of robust, dynamic measures and assessments of team knowledge development, knowledge accumulation, and knowledge expression (Salas, Vessey, et al., 2017). The findings of this study provide empirical results from a field study and offer a path to improve current theories of knowledge development. More robust assessment tools are needed to further the literature. This study connects theory to application by examining how behavioral markers may improve assessment during field observations.

Findings from this study can inform refinements to recent theories of knowledge emergence (Grand et al., 2016). Currently, the development of team cognition does not account for how team attitudes affect knowledge emergence in teams (Grand et al., 2016). The patterns of team cohesion and collective efficacy identified during this study elucidate how the affective domain impacts team dynamics. By exploring patterns of teamwork skills, this study found potential areas where theory could be improved by including team attributes as mediators of teamwork skills. Adapting knowledge emergence frameworks to include elements of cohesion and efficacy could mitigate gaps in the literature and improve outcomes during field research.

**Implications for policy.** Army policymakers within TRADOC can employ findings from this study. As TRADOC updates the concepts and techniques to train and educate soldiers, decision-makers should consider including teamwork skill development as a pillar of their training strategy. Developing training specific to teamwork skills may improve communication at the lower-echelons where agile and adaptive teams are developed. Deliberate teamwork skill training is robust against new threats and meets the TRADOC mission of preparing the Army to meet and defeat near-peer adversaries.

Combat is a complex phenomenon; adapting to evolving conditions on the battlefield require teamwork skills. Decision-makers within the Army can utilize findings from this study to address the growing need for agile teams and squads (U.S. Department of the Army, 2017d). Specifically, this study can improve the development of procedures that cultivates teamwork skills at the squad level. Teamwork skills have a measurable impact on team performance (Hanley et al., 2018; Milham et al., 2017). The Army, through its very organization and nature, produces cohesive teams (U.S. Department of the Army, 2017c). Perseverance in the face of opposition can be a powerful force when building cohesive teams, yet the implications of this study suggest that Army teams may not be optimizing cohesion to improve performance. Providing team training in teamwork skills may remedy this issue. To improve performance of Army teams in dynamic environments, Army policymakers should deliberately and systematically include in team training both team cohesion and team efficacy as the antecedents of team performance.

Army policymakers can also utilize findings from this study to improve assessment techniques for measuring squad performance. The Army is currently refocusing on readiness and training (Berglund & Filiberti, 2017). Maintaining or improving readiness is predicated on measuring and assessing the current level of preparedness. This study informs the development of improved measurement tools that can aid assessment. Improved measurement and assessment can aid Army combat developers to address gaps in performance readiness at the squad level.

**Implications for professional practice.** Researchers in education and the social sciences should be cautious not to overemphasize conclusions from Likert scores, which appear to be especially limiting. Self-report measures, in general, are useful, but they should not be heavily relied on unless they are obtained in conjunction with objective measures (Kozlowski, 2015). The 20 behavioral markers this study explores are opportunities for professional practice to include objective measures in conjunction with static Likert scores. The combining of Likert scales with behavioral markers would provide professional practitioners assurance that their tools are accurately measuring the appropriate antecedents of team performance.

There is an urgent need for team research in a field environment (U.S. Department of the Army, 2017b; Townsend et al., 2018). Army tactical commanders focus on results and outcomes (U.S. Department of the Army, 2015b). This study provides meaningful, actionable research by taking the SOvM study to its natural conclusion. Training interventions that improve performance would be useful to tactical leaders in the Army who will likely be interested in these findings.

Army teams face a variety of threats in complex environments where situations rapidly change. The life-and-death consequences of poor performance in a combat engagement compound the complexity of the environment. Soldiers need team debriefs that address performance from a holistic perspective (i.e., both teamwork skills and taskwork skills) to train at the team level effectively. Including teamwork skills in debriefs will allow soldiers to make the most gains from training and thereby improve their combat readiness.

The findings of this study address current measurement shortcomings in practice evaluation. The findings from RQ1 and RQ2 can inform the development of improved measurement tools, which in turn would enhance evaluators' ability to assess training programs accurately. For instance, training evaluators who are currently using self-report measures in assessing performance improvements following an intervention should consider including behavioral markers or other objective measurements as criteria. Improved measurement tools will enhance evaluators' findings by establishing a connection between the training intervention and the ultimate goal.

**Unexpected findings.** The most surprising result of this study was that the intervention improved the SOF teams' performance. The researcher suspected that teamwork skills might improve performance in conventional units but was not expecting this result to emerge in SOF teams as well. For additional perspective, SOF units invest considerable time and money in each soldier's training. Specialty schools like Army Ranger School, Special Forces Sniper School, Combat Diver School, and Military Parachute Freefall School are just a few examples. Intuition biased the researcher, and he was stunned that the performance in such elite teams would also improve with a teamwork skills intervention.

## Suggestions for Future Research

Future research could separate the training elements of the intervention to determine which elements provide the most benefit. However, this researcher's recommendation is to keep the training intervention intact. Even if the TC3 training does not have a significant effect on tactical performance, its life-saving skills may produce second-and third-order effects with long-term benefits. TC3 training included teamwork skills but focused on how soldiers should work together during incidents involving injured friendly troops and civilian casualties. Future research should aim to replicate these findings in a multilevel design.

Separately, future research should work to confirm and replicate the findings of this study with a larger sample size. Specifically, the researcher recommends conducting a traditional quasi-experimental design with two conventional-unit infantry battalions with approximately 50 squads. Utilizing battalions from a conventional unit minimizes the number of groups in the study, which would increase statistical power. Ideally, future research would randomly assign squads to either an experimental or a control group, but this may be problematic for the Army logistically. In this case, assigning an infantry battalion of 25 squads to a condition would reduce the logistical burden. To reduce the administrative burden, the follow-up study could be conducted in concert with the unit's existing training schedule.

Ample opportunities exist for studying squad tactical performance. For instance, squad-level qualifications occur during Squad Table Six, formerly called Squad Army Training and Evaluation Program (U.S. Department of the Army, 2015a). Squad evaluations are a perennial requirement that provide an opportunity for leaders to observe their units at the squad level before incorporating them within larger units, such as a company or a battalion. Integrating the intervention with existing squad-level training will minimize the necessary logistical resources, costs, and burdens to the supporting unit.

## Limitations and Reflexivity

**Limitations.** As with all large-scale field research experiments, issues arose during the original study that may have affected the raw data, and any effect on the raw data would have affected the findings and results of this study. First, the original SOvM study design included eight squads: four in the control condition and four in the experimental condition. Initially, half of the participating squads were supposed to come from the Marine Corps and the other half from the Army. This design might have increased the generalizability of the findings. However, the Marine Corps teams pulled out of the experiment shortly before execution, resulting in the study leads needing to find a replacement on short notice. Soldiers from an SOF unit replaced the Marines.

Replacing the Marine Corps teams with SOF teams had three consequences that may have affected the raw data used in this study. First, the SOF unit had not planned to support this experiment; as such, they provided a random selection of personnel. While the conventional unit soldiers were task-organized teams accustomed to working together, the SOF unit soldiers had not worked together as a team before this experiment. Second, all conventional unit teams were "line" infantry soldiers. A line squad is the most typical formation of infantry soldiers, so it makes sense that the SOvM study constructed scenarios for a line squad. However, three of the nine SOF teams were from a "weapons squad," which is a special-purpose squad whose core mission differs from the types of tasks involved in the experiment scenarios. Third, because the SOF soldiers were called in on late notice, they were also short on personnel. The SOF teams comprised three soldiers, while the conventional teams were at full strength (i.e., four soldiers). During the execution of the scenarios, most teams incurred at least one casualty. Due to their reduced numbers, the SOF unit teams were disproportionately disadvantaged when the scenario created casualties, and this may have impacted their performance. Another limitation is potential bias in the SME observers who rated the performance of the teams. One of the senior non-commissioned officers is currently serving in a conventional unit, while the other is currently serving in a special operations unit. However, both SMEs have served in special operations units in the past. This experience could have led them to have higher performance expectations for the special operations teams than for the conventional forces teams.

Ultimately, the researcher analyzed data from 21 teams: nine in the experimental condition and 12 in the control condition. The experimental condition contained three SOF teams and six conventional teams and, as noted above, the SOF unit teams were not an integral line team. Any interaction of the limitations noted above could have influenced the data and consequently the findings. Most of the limiting factors placed the SOF units at a disadvantage compared to the conventional units. On average, the SOF teams outperformed the conventional teams. The researcher recommends that future research focus on conventional units only rather than conventional units and SOF units. The reduction in group type will strengthen the statistical power of the study and provide more precise insight into the effect of the training intervention.

**Reflexivity.** Through conducting this study, the researcher gained a greater appreciation for the challenges of team research, particularly with dismounted soldier teams. Team research, compared to other research approaches, is challenging in new and different ways. Controlling for variables is necessarily more difficult at the team level than it is at the individual level. Additionally, training dismounted soldiers in realistic combat environments introduces variables that are extraordinarily difficult to control. Teams exhibited the most relevant behaviors when the scenario was most chaotic. The natural inclination for research is to exert more control over the environment; however, there is a tradeoff between experimental control and realism. Soldiers, particularly combat veterans, are highly sensitive to artificiality in field training. Controlling for too many variables and thereby subjecting soldiers to rigid control measures that are not present in real life may negatively affect team motivation. Conversely, a lack of experimental control makes comparing teams more challenging.

During data collection, some approaches worked well, and others did not. Among the approaches that particularly worked well was the use of consensus regarding SME ratings. At the recommendation of the dissertation committee, the researcher employed a consensus model to adjudicate differences in SME performance ratings. During data collection, the consensus model did often result in delays, the SMEs would discuss in great detail, for instance, why a particular team should be rated a four rather than a two. While the consensus model extended the time it took to collect the data, the benefits outweighed the cost.

The benefit of the consensus model was two-fold. First, while merely averaging the two SME scores would have been arithmetically sound, much would have been lost. While adjudicating scores, the SMEs would respectfully argue their positions, advocating for a particular score and supporting their assertions using the PRMG and real-world examples. This advocacy period forced the SMEs to think deeply and critically about their rationales, which likely improved the consistency of the performance scores. Second, the SMEs ultimately came to a consensus on each of the performance ratings, an act which negated the need for the researcher to apply a post-hoc rationale for a particular scoring model. Also, while the SMEs occasionally agreed to average their scores, most of the time, one SME convinced the other that a particular rating was appropriate.

The dissertation process has allowed the researcher to develop as a writer and a thinker. Throughout writing this dissertation, the researcher has improved his conceptual understanding of empirical research. Precisely, the researcher understands the importance of narrowly defining the scope of a study. A narrow scope facilitates a thorough analysis of the subject matter.

Loosely defined parameters of a study are unwieldy and difficult to manage. Specifying the scope of a study allows the researcher to think deeply on a particular concept without wasting resources, cognitive or otherwise, on activities that are not germane to the subject of study.

A similarly arduous experience came to the researcher's mind while reflecting on the dissertation process. The researcher graduated from Army Ranger School in October 2000 and will graduate from UWF in 2019. A Ranger School graduate wears a uniform tab signifying completion of the course, similar to how the title of "doctor" signifies completing a doctorate. Both the Ranger tab and the "Dr." are visible displays that signal to laypeople a measure of expertise. Ranger School is the Army's premier leadership school. However, graduation from Ranger School is not the culminating event; instead, it is the beginning of a new set of expectations and a new level of responsibility. Completing this dissertation and joining the company of scholars offers an academic parallel: graduation with a doctorate is not a culminating event, but the beginning of new expectations, responsibilities, and obligations to fellow scholars and the scientific community.

**Chapter Summary**

This study explored the following overarching question: What are the taskwork and teamwork skills of selected combat soldiers in training situations in the Southeastern United States? The question was explored utilizing existing video and audio files from a recent field experiment with U.S. Army teams. This study explored patterns of teamwork skills reflective of team cohesion and collective efficacy. The findings from this study confirmed findings from previous studies that cautioned against overreliance on self-report measures and suggested that augmenting self-reports with behavioral markers could improve measurement accuracy. This study includes a purpose-built BMMS that future researchers can modify and adapt research with a similar population.

The literature largely supports claims that objective measures outperform self-report measures. However, self-report measures remain widely used because they are relatively cost-effective and easy to administer, while more objective observations are time-consuming. The research team listened to audio files for evidence of behavioral markers, spending roughly 3.5 hours per team for a total of 21 teams; added to the total of more than 70 hours of listening was the time spent conducting the instrument review and analysis. As such, this researcher understands the time investment involved in using behavioral markers to augment the more traditional but less intensive measurements of Likert scales. However, this research indicates that it is worth pursuing options apart from the default Likert scales when the criterion measure matters.

The study also found that a teamwork skills intervention improved tactical performance in Army infantry squads. Surprisingly, this effect occurred even with special operations units. These findings suggest that teamwork skills are fundamental to team performance and therefore need to be systematically trained and assessed in order to ensure their development. Dismounted infantry teams operate in some of the most complex and dangerous environments on Earth. Army researchers should aggressively pursue training interventions that improve performance outcomes. The findings of this study are encouraging, and researchers should work deliberately to replicate the findings in future large-scale field experiments in order to coordinate with Army decision-makers to implement the intervention in the force.

**References**

Abrantes, A. C. M., Passos, A. M., Cunha, M. P., & Santos, C. M. (2018). Bringing team improvisation to team adaptation: The combined role of shared temporal cognitions and team learning behaviors fostering team performance. *Journal of Business Research*, *84*, 59–71. https://doi.org/10.1016/j.jbusres.2017.11.005

Allen, J. A., Reiter-Palmon, R., Crowe, J., & Scott, C. (2018). Debriefs: Teams learning from doing in context. *The American Psychologist*, *73*(4), 504–516. https://doi.org/10.1037/amp0000246

Asamoah, B., & Grobbelaar, H. (2017). Team cohesion and performance during a university soccer championship: Two sides of the coin. *South African Journal for Research in Sport, Physical Education and Recreation*, *39*(1), 1–15. Retrieved from https://www.sajrsper.com/

Aubé, C., Brunelle, E., & Rousseau, V. (2014). Flow experience and team performance: The role of team goal commitment and information exchange. *Motivation and Emotion*, *38*(1), 120–130. https://doi.org/10.1007/s11031-013-9365-2

Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance. *Journal of Applied Psychology*, *88*(5), 866–878. https://doi.org/10.1037/0021-9010.88.5.866

Baard, S. K., Rench, T. A., & Kozlowski, S. W. (2014). Performance adaptation: A theoretical integration and review. *Journal of Management*, *40*(1), 48–99. https://doi.org/10.1177/0149206313488210

Bachrach, D. G., & Mullins, R. (2019). A dual-process contingency model of leadership, transactive memory systems and team performance. *Journal of Business Research*, *96*(3), 297–308. https://doi.org/10.1016/j.jbusres.2018.11.029

Bailey, C. R., & Bailey, C. A. (2017). *A guide to qualitative field research*. SAGE Publications.

Bartone, P. T., Krueger, G. P., & Bartone, J. V. (2018). Individual differences in adaptability to isolated, confined, and extreme environments. *Aerospace Medicine & Human Performance*, *89*(6), 536–546. https://doi.org/10.3357/AMHP.4951.2018

Bayraktar, S. (2017). Team cohesion: A multi method study of bank employees in Turkey. *Hacettepe Universitesi Iktisadi ve Idari Bilimler Fakultesi Dergisi/Hacettepe University Journal of Economics and Administrative Sciences*, *35*(2), 1–21. Retrieved from http://dergipark.gov.tr/huniibf

Bell, S. T., Fisher, D. M., Brown, S. G., & Mann, K. E. (2016). An approach for conducting actionable research with extreme teams. *Journal of Management*, 44(7), 2740–2765. https://doi.org/10.1177/0149206316653805

Blaser, M. A., & Seiler, R. (2019). Shared knowledge and verbal communication in football: Changes in team cognition through collective training. *Frontiers in Psychology*, *10*, 1-8. https://doi.org/10.3389/fpsyg.2019.00077

Berglund, C. M. J., & Filiberti, E. J. (2017). *Improving readiness in the United States Army National Guard* (Strategy Research Project). Carlisle, PA: U.S. Army War College. Retrieved from http://publications.armywarcollege.edu/pubs/3391.pdf

Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher*, *13*(6), 4-16. https://doi.org/10.2307/1175554

Bickley, W. R., Pleban, R. J., Diedrich, F., Sidman, J., Semmens, R., & Geyer, A. (2010). *Army institutional training: Current status and future research* (Technical Report No. 1921). Arlington, VA: Army Research Institute for the Behavioral and Social Sciences. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a516971.pdf

Boies, K., Fiset, J., & Gill, H. (2015). Communication and trust are key: Unlocking the relationship between leadership and team performance and creativity. *The Leadership Quarterly*, *26*(6), 1080–1094. https://doi.org/10.1016/j.leaqua.2015.07.007

Bolton, F. C. (2016). Use of the after-action review to improve learning. *Assessment Update*, 28(2), 3–15. https://doi.org/10.1002/au.30051

Borman, W. C., & Smith, T. N. (2012). The use of objective measures as criteria in I/O psychology. *The Oxford Handbook of Personnel Assessment and Selection*. https://doi.org/10.1093/oxfordhb/9780199732579.013.0023

Brewer, E. C., & Holmes, T. L. (2016). Better communication = better teams: A communication exercise to improve team performance. *IEEE Transactions on Professional Communication*, *59*(3), 288–298. https://doi.org/10.1109/TPC.2016.2590018

Brown, L. L., & Overly, F. L. (2016). Simulation-based interprofessional team training. *Clinical Pediatric Emergency Medicine*, *17*(3), 179–184. https://doi.org/10.1016/j.cpem.2016.06.001

Bush, J. T., LePine, J. A., & Newton, D. W. (2018). Teams in transition: An integrative review and synthesis of research on team task transitions and propositions for future research. *Human Resource Management Review*, *28*(4), 423–433. https://doi.org/10.1016/j.hrmr.2017.06.005

Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology*, *85*(2), 273–283. Retrieved from https://www.apa.org/index

Cannon-Bowers, J. A., & Salas, E. (1990). Cognitive psychology and team training: Shared mental models and team training. Presented at the 5th annual meeting of the Society for Industrial and Organizational Psychology, Miami, FL. Retrieved from http://www.siop.org/default.aspx

Cannon-Bowers, J. A., & Salas, E. (2001). Reflections on shared cognition. *Journal of Organizational Behavior*, *22*(2), 195–202. https://doi.org/10.1002/job.82

Cannon-Bowers, J. A., Salas, E., Tannenbaum, S., & Mathieu, J. (1995). Toward theoretically based principles of training effectiveness: A model and initial empirical investigation. *Military Psychology (Taylor & Francis Ltd)*, *7*(3), 141–164. https://doi.org/10.1207/s15327876mp0703_1

Cooke, N. J. (2015). Team cognition as interaction. *Current Directions in Psychological Science*, *24*(6), 415–419. https://doi.org/10.1177/0963721415602474

Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R., Bowers, C., & Cannon-Bowers, J. A. (2003). Measuring team knowledge: A window to the cognitive underpinnings of team performance. *Group Dynamics: Theory, Research, and Practice*, *7*(3), 179-199. https://doi.org/10.1037/1089-2699.7.3.179

Cooke, N. J., Salas, E., Kiekel, P. A., & Bell, B. (2004). Advances in measuring team cognition. In *Team cognition: Understanding the factors that drive process and performance* (pp. 83–106). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/10690-005

Corneliussen, J. G., Leon, G. R., Kjærgaard, A., Fink, B. A., & Venables, N. C. (2017). Individual traits, personal values, and conflict resolution in an isolated, confined, extreme environment. *Aerospace Medicine and Human Performance*, *88*(6), 535–543. https://doi.org/10.3357/AMHP.4785.2017

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Los Angeles, CA: SAGE Publications.

Crichton, M. T. (2017). From cockpit to operating theatre to drilling rig floor: Five principles for improving safety using simulator-based exercises to enhance team cognition. *Cognition, Technology & Work*, *19*(1), 73–84. https://doi.org/10.1007/s10111-016-0396-9

DeCaporale-Ryan, L. N., Dadiz, R., & Peyre, S. E. (2016). Simulation-based learning: From theory to practice. *Families, Systems & Health*, *34*(2), 159-162. https://doi.org/10.1037/fsh0000203

DeChurch, L. A., & Mesmer-Magnus, J. R. (2010). The cognitive underpinnings of effective teamwork: A meta-analysis. *Journal of Applied Psychology*, *95*(1), 32-53. https://doi.org/10.1037/a0017328

Denzin, N. K., & Lincoln, Y. S. (2000). *Handbook of qualitative research*. Thousand Oaks, CA: SAGE Publications.

Dermeval, D., Paiva, R., Bittencourt, I. I., Vassileva, J., & Borges, D. (2018). Authoring tools for designing intelligent tutoring systems: A systematic review of the literature. *International Journal of Artificial Intelligence in Education (Springer Science & Business Media B.V.)*, *28*(3), 336-384. https://doi.org/10.1007/s40593-017-0157-9

DiRosa, G. A., Estrada, A. X., & DeCostanza, A. H. (2015). Cohesion with large collectives: A multiteam systems perspective. In S. Poole (Ed.), *Team Cohesion: Advances in*

*Psychological Theory, Methods and Practice* (Vol. 17, pp. 25–52). Bingley, UK: Emerald Group Publishing Limited. https://doi.org/10.1108/S1534-085620150000017003

Donaldson, S. I., & Grant-Vallone, E. J. (2002). Understanding self-report bias in organizational behavior research. *Journal of Business and Psychology*, *17*(2), 245-260. https://doi.org/10.1023/A:1019637632584

Driskell, T., Salas, E., & Driskell, J. E. (2017). Teams in extreme environments: Alterations in team development and teamwork. *Human Resource Management Review, 28*(4), 434-449. https://doi.org/10.1016/j.hrmr.2017.01.002

Eden, D. (2017). Field experiments in organizations. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*(1), 91–122. https://doi.org/10.1146/annurev-orgpsych-041015-062400

Ellwart, T., Happ, C., Gurtner, A., & Rack, O. (2015). Managing information overload in virtual teams: Effects of a structured online team adaptation on cognition and performance. *European Journal of Work and Organizational Psychology*, *24*(5), 812–826. https://doi.org/10.1080/1359432X.2014.1000873

Estrada, A. X., & Severt, J. B. (2015). On the function and structure of group cohesion. In S. Poole (Ed.), *Team cohesion: Advances in psychological theory, methods and practice* (Vol. 17, pp. 3–24). Bingley, UK: Emerald Group Publishing Limited.

Fernandez, R., Shah, S., Rosenman, E. D., Kozlowski, S. W. J., Parker, S. H., & Grand, J. A. (2017). Developing team cognition. *Simulation in Healthcare*, *12*(2), 96-103. https://doi.org/10.1097/SIH.0000000000000200

Fiscella, K., Mauksch, L., Bodenheimer, T., & Salas, E. (2017). Improving care teams' functioning: Recommendations from team science. *The Joint Commission Journal on Quality and Patient Safety*, *43*(7), 361–368. https://doi.org/10.1016/j.jcjq.2017.03.009

Fletcher, R. B., Wilkinson, H., Bladon, H., & Gargiulo, A. (2017). Developing a measure of collective efficacy for female netball using polytomous item response modeling and multilevel confirmatory analysis. *Group Dynamics*, *21*(2), 61-76. http://dx.doi.org/10.1037/gdn0000062

Fuster-Parra, P., García-Mas, A., Ponseti, F. J., & Leo, F. M. (2015). Team performance and collective efficacy in the dynamic psychology of competitive team: A Bayesian network analysis. *Human Movement Science*, *40*(4), 98-118. https://doi.org/10.1016/j.humov.2014.12.005

Gardner, A. K., Scott, D. J., & Abdelfattah, K. R. (2017). Do great teams think alike? An examination of team mental models and their impact on team performance. *Surgery*, *161*(5), 1203-1208. https://doi.org/10.1016/j.surg.2016.11.010

Gardner, H. K., Gino, F., & Staats, B. R. (2012). Dynamically integrating knowledge in teams: Transforming resources into performance. *Academy of Management Journal*, *55*(4), 998–1022 https://doi.org/10.5465/amj.2010.0604

George, K. L., & Quatrara, B. (2018). Interprofessional simulations promote knowledge retention and enhance perceptions of teamwork skills in a surgical-trauma-burn intensive care unit setting. *Dimensions of Critical Care Nursing*, *37*(3), 144-155. https://doi.org/10.1097/DCC.0000000000000301

Gevers, J. M. P., Uitdewilligen, S., & Passos, A. M. (2015). Dynamics of team cognition and team adaptation: Introduction to the special issue. *European Journal of Work and*

*Organizational Psychology*, *24*(5), 645–651. https://doi.org/10.1080/1359432X.2015.1065251

Goldberg, B., Amburn, C., Ragusa, C., & Chen, D.-W. (2018). Modeling expert behavior in support of an adaptive psychomotor training environment: A marksmanship use case. *International Journal of Artificial Intelligence in Education (Springer Science & Business Media B.V.)*, *28*(2), 194-224. https://doi.org/10.1007/s40593-017-0155-y

González-Ortega, D., Díaz-Pernas, F. j., Martínez-Zarzuela, M., & Antón-Rodríguez, M. (2014). A Kinect-based system for cognitive rehabilitation exercises monitoring. *Computer Methods and Programs in Biomedicine*, *113*(2), 620–631. https://doi.org/10.1016/j.cmpb.2013.10.014

Goodwin, G. F., Blacksmith, N., & Coats, M. R. (2018). The science of teams in the military: Contributions from over 60 years of research. *American Psychologist*, *73*(4), 322–333. https://doi.org/10.1037/amp0000259

Grand, J. A. (2017). Brain drain? An examination of stereotype threat effects during training on knowledge acquisition and organizational effectiveness. *Journal of Applied Psychology*, *102*(2), 115–150. https://doi.org/10.1037/apl0000171

Grand, J. A., Braun, M. T., Kuljanin, G., Kozlowski, S. W. J., & Chao, G. T. (2016). The dynamics of team cognition: A process-oriented theory of knowledge emergence in teams. *Journal of Applied Psychology*, *101*(10), 1353-1385. https://doi.org/10.1037/apl0000136

Guchait, P. (2016). The mediating effect of team engagement between team cognitions and team outcomes in service-management teams. *Journal of Hospitality & Tourism Research*, *40*(2), 139–161. https://doi.org/10.1177/1096348013495698

Gurbin, T. (2015). Enlivening the machinist perspective: Humanising the information processing theory with social and cultural influences. *Procedia - Social and Behavioral Sciences*, *197*, 2331–2338. https://doi.org/10.1016/j.sbspro.2015.07.263

Haar, S., Li, J., Segers, M., Jehn, K. A., & Bossche, P. V. (2015). Evolving team cognition: The impact of team situation models on team effectiveness. *European Journal of Work and Organizational Psychology*, *24*(4), 596–610. https://doi.org/10.1080/1359432X.2014.942731

Hanley, A., Kedrowicz, A. A., Hammond, S., & Hardie, E. M. (2018). Impact of team communication training on performance and self-assessment of team functioning during sophomore surgery. *Journal of Veterinary Medical Education, 46*(1), 45–55. https://doi.org/10.3138/jvme.0317-046r1

Häske, D., Beckers, S. K., Hofmann, M., Lefering, R., Preiser, C., Gliwitzky, B., . . . Münzberg, M. (2018). Performance Assessment of Emergency Teams and Communication in Trauma Care (PERFECT checklist)—Explorative analysis, development and validation of the PERFECT checklist: Part of the prospective longitudinal mixed-methods EPPTC trial. *PLOS ONE*, *13*(8), e0202795. https://doi.org/10.1371/journal.pone.0202795

Hedlund, E. (2017). Team learning and leadership in multinational military staff exercises. *Armed Forces & Society*, *43*(3), 459–477. https://doi.org/10.1177/0095327X16667088

Herzog, S., & Bowman, N. A. (2011). *Validity and limitations of college student self-report data: New directions for institutional research, number 150*. Hoboken, NJ: John Wiley & Sons.

Hoang, T. N., Kang, J., Siriratsivawong, K., LaPorta, A., Heck, A., Ferraro, J., . . . Walsh, J. (2016). Hyper-realistic, team-centered fleet surgical team training provides sustained improvements in performance. *Journal of Surgical Education*, *73*(4), 668–674. https://doi.org/10.1016/j.jsurg.2016.03.004

Hoch, J. E., & Kozlowski, S. W. (2014). Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership. *Journal of Applied Psychology*, *99*(3), 390-403. http://dx.doi.org/10.1037/a0030264

Hotvet, J. (2016). The art of the debrief: How to conduct an effective after-action review. *Marine Corps Gazette*. Retrieved from https://mca-marines.org/magazines/marine-corps-gazette/

Il-Hyun, J. (2012). Shared mental models on the performance of e-learning content development teams. *Journal of Educational Technology & Society*, *15*(1), 289-297. Retrieved from https://www.j-ets.net/ETS/index.html

Johnston, J. H. (2005). *Towards validating a model for assessing team tactical decision making*. Orlando, FL: Naval Air Systems Command. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a515056.pdf

Johnston, J. H., Gamble, K., Patton, D., Fitzhugh, S., Townsend, L., Milham, L., . . . Wolf, R. (2016). *Squad overmatch study: Phase II initial findings*. Fort Belvoir, VA: Defense Technical Information Center. https://doi.org/10.21236/ADA613853

Johnston, J. H., Poirer, J., & Smith-Jentsch, K. A. (1998). *Decision making under stress: Creating a research methodology*. Washington, DC: American Psychological Association.

Jones, C. (2010). Archival data: Advantages and disadvantages for research in psychology. *Social & Personality Psychology Compass*, *4*(11), 1008-1017. https://doi.org/10.1111/j.1751-9004.2010.00317.x

Kearney, A. R. (2016). *Team health and performance in spaceflight habitats* (NASA Technical Document No. TM-2016-219274). Houston, TX: NASA Johnson Space Center. Retrieved from https://ston.jsc.nasa.gov/collections/trs/_techrep/TM-2016-219274.pdf

Kjærgaard, A., Leon, G. R., & Fink, B. A. (2015). Personal challenges, communication processes, and team effectiveness in military special patrol teams operating in a polar environment. *Environment and Behavior*, *47*(6), 644–666. https://doi.org/10.1177/0013916513512834

Kormos, C., & Gifford, R. (2014). Review: The validity of self-report measures of proenvironmental behavior: A meta-analytic review. *Journal of Environmental Psychology*, *40*, 359–371. https://doi.org/10.1016/j.jenvp.2014.09.003

Kozlowski, S. W. J. (1998). Training and developing adaptive teams: Theory, principles, and research. In J. A. Cannon-Bowers & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training* (pp. 115-153). Washington, DC, US: American Psychological Association.

Kozlowski, S. W. J. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science*, *7*(3) 77–124. https://doi.org/10.1111%2Fj.1529-1006.2006.00030.x

Kozlowski, S. W. J. (2015). Advancing research on team process dynamics: Theoretical, methodological, and measurement considerations. *Organizational Psychology Review*, *5*(4), 270–299. https://doi.org/10.1177%2F2041386614533586

Kozlowski, S. W. J. (2018). Enhancing the effectiveness of work groups and teams: A reflection. *Perspectives on Psychological Science*, *13*(2), 205–212. https://doi.org/10.1177%2F1745691617697078

Kozlowski, S. W. J., & Chao, G. T. (2012). The dynamics of emergence: Cognition and cohesion in work teams. *Managerial & Decision Economics*, *33*(5/6), 335–354. https://doi.org/10.1002/mde.2552

Kozlowski, S. W. J., & Chao, G. T. (2018). Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. *American Psychologist*, *73*(4), 576–592. https://doi.org/10.1037/amp0000245

Kozlowski, S. W. J., Chao, G. T., Grand, J. A., Braun, M. T., & Kuljanin, G. (2013). Advancing multilevel research design: Capturing the dynamics of emergence. *Organizational Research Methods*, *16*(4), 581-615. https://doi.org/10.1177%2F1094428113493119

Kozlowski, S. W. J., Chao, G. T., Grand, J. A., Braun, M. T., & Kuljanin, G. (2016). Capturing the multilevel dynamics of emergence: Computational modeling, simulation, and virtual experimentation. *Organizational Psychology Review*, *6*(1), 3–33. https://doi.org/10.1177%2F2041386614547955

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Kulik, J. A., & Fletcher, J. D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research*, *86*(1), 42–78. https://doi.org/10.3102/0034654315581420

Lacerenza, C. N., Marlow, S. L., Tannenbaum, S. I., & Salas, E. (2018). Team development interventions: Evidence-based approaches for improving teamwork. *The American Psychologist*, *73*(4), 517–531. https://doi.org/10.1037/amp0000295

Laurence, J. H., & Matthews, M. D. (2012). *The Oxford handbook of military psychology*. New York, NY: Oxford University Press.

Lee, D., Stajkovic, A. D., & Sergent, K. (2016). A field examination of the moderating role of group trust in group efficacy formation. *Journal of Occupational and Organizational Psychology*, *89*(4), 856-876. https://doi.org/10.1111/joop.12161

Levine, J. M. (2018). Socially-shared cognition and consensus in small groups. *Current Opinion in Psychology*, *23*, 52–56. https://doi.org/10.1016/j.copsyc.2017.12.003

Macht, G. A., & Nembhard, D. A. (2015). Measures and models of personality and their effects on communication and team performance. *International Journal of Industrial Ergonomics*, *49*, 78–89. https://doi.org/10.1016/j.ergon.2015.05.006

Marlow, S. L., Lacerenza, C. N., Paoletti, J., Burke, C. S., & Salas, E. (2018). Does team communication represent a one-size-fits-all approach? A meta-analysis of team communication and performance. *Organizational Behavior and Human Decision Processes*, *144*, 145–170. https://doi.org/10.1016/j.obhdp.2017.08.001

Marlow, S. L., Lacerenza, C. N., & Salas, E. (2017). Communication in virtual teams: a conceptual framework and research agenda. *Human Resource Management Review*, *27*(4), 575–589. https://doi.org/10.1016/j.hrmr.2016.12.005

Marriage, B., & Kinnear, J. (2016). Review: Assessing team performance – markers and methods. *Trends in Anaesthesia and Critical Care*, *7–8*, 11–16. https://doi.org/10.1016/j.tacc.2016.05.002

Mathieu, J. E., Hollenbeck, J. R., van Knippenberg, D., & Ilgen, D. R. (2017). A century of work teams in the Journal of Applied Psychology. *The Journal of Applied Psychology*, *102*(3), 452–467. https://doi.org/10.1037/apl0000128

Matthews, M. D. (2013). *Head strong: How psychology is revolutionizing war*. New York, NY: Oxford University Press.

McEwan, D., Ruissen, G. R., Eys, M. A., Zumbo, B. D., & Beauchamp, M. R. (2017). The effectiveness of teamwork training on teamwork behaviors and team performance: A systematic review and meta-analysis of controlled interventions. *Plos One*, *12*(1), e0169604–e0169604. https://doi.org/10.1371/journal.pone.0169604

McNeese, N. J., & Reddy, M. C. (2017). The role of team cognition in collaborative information seeking. *Journal of the Association for Information Science and Technology*, *68*(1), 129–140. https://doi.org/10.1002/asi.23614

Mell, J. N., Van Knippenberg, D., & Van Ginkel, W. P. (2014). The catalyst effect: The impact of transactive memory system structure on team performance. *Academy of Management Journal*, *57*(4), 1154–1173. https://doi.org/10.5465/amj.2012.0589

Mesmer-Magnus, J. R., & Dechurch, L. A. (2009). Information sharing and team performance: A meta-analysis. *The Journal of Applied Psychology*, *94*(2), 535–546. https://doi.org/10.1037/a0013773

Milham, L. M., Phillips, H. L., Ross, W. A., Townsend, L. N., Riddle, D. L., Smith, K. M., . . . Johnston, J. H. (2017). Squad-level training for tactical combat casualty care: Instructional approach and technology assessment. *Journal of Defense Modeling & Simulation*, *14*(4), 345-360. https://doi.org/10.1177/1548512916649075

Mohammed, S., & Hamilton, K. (2010). Metaphor no more: A 15-year review of the team mental model construct. *Journal of Management*, *36*(4), 876–910. https://doi.org/10.1177%2F0149206309356804

Mundweil, P. J. (2013). *Overmatch: Enabling the infantry rifle squad as the foundation of the decisive force* (SAMS Report No. ATZL-SWV). Fort Leavenworth, KS: Army Command and General Staff College. Retrieved from http://www.dtic.mil/docs/citations/ADA587318

Murphy, M., Curtis, K., & McCloughen, A. (in press). Facilitators and barriers to the clinical application of teamwork skills taught in multidisciplinary simulated trauma team training. *Injury: International Journal of the Care of the Injured*. https://doi.org/10.1016/j.injury.2019.01.026

Paris, C., Johnston, J. H., & Reeves, D. (2000). A schema-based approach to measuring team decision making in a Navy combat information center. In C. McCann & R. Pigeau (Eds.), *The Human in Command* (pp. 263–278). Boston, MA: Springer. https://doi.org/10.1007/978-1-4615-4229-2_18

Park, W.-W., Kim, M. S., & Gully, S. M. (2017). Effect of cohesion on the curvilinear relationship between team efficacy and performance. *Small Group Research*, *48*(4), 455–481. https://doi.org/10.1177/1046496417709933

Passos, A. M., Peus, C., Weisweiler, S., Raes, A. M. L., Standifer, R. L., & Santos, C. M. (2015). Time in teams: cognitions, conflict and team satisfaction. *Journal of Managerial Psychology*, *30*(6), 692–708. https://doi.org/10.1108/JMP-09-2012-0278

Paul, R., Drake, J. R., & Liang, H. (2016). Global virtual team performance: The effect of coordination effectiveness, trust, and team cohesion. *IEEE Transactions on Professional Communication*, *59*(3), 186–202. https://doi.org/10.1109/TPC.2016.2583319

Peltokorpi, V., & Hasu, M. (2014). Transactive memory systems and team innovation: A curvilinear approach. *Team Performance Management*, *20*(5/6), 262–272. https://doi.org/10.1108/TPM-04-2014-0031

Phillips, J. K., Ross, K. G., & Shadrick, S. B. (2006). *User's guide for tactical thinking behaviorally anchored rating scales* (Research Product Report No. 622785A790). Retrieved from Army Research Institute for the Behavioral and Social Sciences website: https://apps.dtic.mil/dtic/tr/fulltext/u2/a452069.pdf

Phillips, J. K., Shafer, J., Ross, K. G., Cox, D. A., & Shadrick, S. B. (2006). *Behaviorally anchored rating scales for the assessment of tactical thinking mental models* (Research Report No. 1854). Retrieved from https://apps.dtic.mil/dtic/tr/fulltext/u2/a452068.pdf

Poysa, J., Elen, J., & Tarhonen, P. (2016). Student teams' development over time: tracing the relationship between the quality of communication and teams' performance. *Higher Education Research & Development*, *35*(4), 787-799. doi:10.1080/07294360.2015.1137887

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *5*, 56-79. https://doi.org/10.1186/1479-5868-5-56

Rapp, T. l., Bachrach, D. g., Rapp, A. a., & Mullins, R. (2014). The role of team goal monitoring in the curvilinear relationship between team efficacy and team performance. *Journal of Applied Psychology*, *99*(5), 976-987. http://dx.doi.org/10.1037/a0036978

Read, K., & Charles, R. (2018). Understanding teamwork errors in royal air force air traffic control. *Safety Science*, *109*, 36–45. https://doi.org/10.1016/j.ssci.2018.04.030

Reinemann, J., LaBell, K., Bellew, C., Asmar, A., Cendán, J., & Harris, D. M. (2015). Integration and improvement of teamwork skills in first year medical students by using physiology-based high fidelity patient simulations. *Medical Science Educator*, *25*(4), 503–512. https://doi.org/10.1007/s40670-015-0161-3

Reitz, E. A., & Seavey, K. (2016). Virtual dismounted infantry training: Requiem for a dream. *Interservice/Industry Training, Simulation, and Education Conference*. Retrieved from https://www.researchgate.net/profile/Emilie_Reitz/publication/312083833_Virtual_Dismounted_Infantry_Training_Requiem_for_a_Dream/links/586e4e0008aebf17d3a73bca.pdf

Richland, L. E., Chan, T.-K., Morrison, R. G., & Au, T. K.-F. (2010). Young children's analogical reasoning across cultures: Similarities and differences. *Journal of Experimental Child Psychology*, *105*(1–2), 146–153. https://doi.org/10.1016/j.jecp.2009.08.003

Riojas, C., & Austin, A. (2017). Semper gumby: Team and leadership training for deployed trauma teams. *Military Medicine*, *182*(11–12), 1752–1756. https://doi.org/10.7205/MILMED-D-17-00155

Roberts, C. M. (2010). *The dissertation journey: A practical and comprehensive guide to planning, writing, and defending your dissertation* (2nd ed.). Thousand Oaks, CA: Corwin Press.

Roberts, N. K., Williams, R. G., Schwind, C. J., Sutyak, J. A., McDowell, C., Griffen, D., . . . Wetter, N. (2014). The impact of brief team communication, leadership and team behavior training on ad hoc team performance in trauma care settings. *The American Journal of Surgery*, *207*(2), 170–178. https://doi.org/10.1016/j.amjsurg.2013.06.016

Ron, N., Lipshitz, R., & Popper, M. (2006). How organizations learn: Post-flight reviews in an F-16 fighter squadron. *Organization Studies*, *27*(8), 1069–1089. https://doi.org/10.1177/0170840606064567

Rudestam, K. E., & Newton, R. R. (2015). *Surviving your dissertation: A comprehensive guide to content and process*. Thousand Oaks, CA: SAGE Publications.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: discoveries and developments. *Human Factors*, *50*(3), 540–547. https://doi.org/10.1518/001872008X288457

Salas, E., Estrada, A. X., & Vessey, W. B. (2015). *Team cohesion: Advances in psychological theory, methods and practice*. Bingley, UK: Emerald Group Publishing.

Salas, E., & Fiore, S. M. (2004). *Team cognition: Understanding the factors that drive process and performance*. Washington, DC: American Psychological Association.

Salas, E., Fiore, S. M., & Letsky, M. P. (Eds.). (2011). *Theories of team cognition: Cross-disciplinary perspectives* (1st ed.). New York, NY: Routledge.

Salas, E., Kozlowski, S. W. J., & Chen, G. (2017). A century of progress in industrial and organizational psychology: Discoveries and the next century. *Journal of Applied Psychology*, *102*(3), 589–598. https://doi.org/10.1037/apl0000206

Salas, E., Reyes, D. L., & McDaniel, S. H. (2018). The science of teamwork: Progress, reflections, and the road ahead. *American Psychologist*, *73*(4), 593–600. https://doi.org/10.1037/amp0000334

Salas, E., Vessey, W. B., & Landon, L. B. (Eds.). (2017). *Team dynamics over time* (Vol. 18). Bingley, UK: Emerald Publishing Limited. https://doi.org/10.1108/S1534-0856201618

Sawyer, T. L., & Deering, S. (2013). Adaptation of the U.S. Army's after-action review for simulation debriefing in healthcare. *Society for Simulation in Healthcare*, *8*(6), 388–397. https://doi.org/10.1097/SIH.0b013e31829ac85c

Scales, B. (2016). *Scales on war: The future of America's military at risk*. Annapolis, MD: Naval Institute Press.

Schwartz, A. J., Boduroglu, A., & Gutchess, A. H. (2014). Cross-cultural differences in categorical memory errors. *Cognitive Science*, *38*(5), 997–1007. https://doi.org/10.1111/cogs.12109

Smith, S., Farra, S., Ten Eyck, R., & Bashaw, M. (2015). Development of an instrument to measure nursing student teamwork skills. *Clinical Simulation in Nursing*, *11*(12), 507–512. https://doi.org/10.1016/j.ecns.2015.10.006

Smith-Jentsch, K. A., Cannon-Bowers, J. A., Tannenbaum, S. I., & Salas, E. (2008). Guided team self-correction: Impacts on team mental models, processes, and effectiveness. *Small Group Research*, *39*(3), 303–327. https://doi.org/10.1177/1046496408317794

Smith-Jentsch, K. A., Johnston, J. H., & Payne, S. C. (1998). Measuring team-related expertise in complex environments. In J. A. Cannon-Bowers, A. Janis, & E. Salas (Eds.), *Making Decisions under Stress: Implications for Individual and Team Training*, *1*, 61–87. https://doi.org/10.1037/10278-000

Song, C., Park, K. R., & Kang, S.-W. (2015). Servant leadership and team performance: The mediating role of knowledge-sharing climate. *Social Behavior and Personality: An International Journal*, *43*(10), 1749–1760. https://doi.org/10.2224/sbp.2015.43.10.1749

Sottilare, R. A., Burke, C. S., Salas, E., Sinatra, A. M., Johnston, J. H., & Gilbert, S. B. (2017). Designing adaptive instruction for teams: A meta-analysis. *International Journal of*

*Artificial Intelligence in Education*, *28*(2), 1–40. https://doi.org/10.1007/s40593-017-0146-z

Sottilare, R. A., Holden, H. K., Brawner, K. W., & Goldberg, B. S. (2011). *Challenges and emerging concepts in the development of adaptive, computer-based tutoring systems for team training*. Orlando, FL: Army Research Laboratory. Retrieved from https://apps.dtic.mil/dtic/tr/fulltext/u2/a558641.pdf

Sottilare, R. A., & Proctor, M. (2012). Passively classifying student mood and performance within intelligent tutors. *Educational Technology & Society*, *15*(2), 101-114. Retrieved from https://www.jstor.org/journal/jeductechsoci

Spiker, V. A., & Johnston, J. H. (2013). Assessing counter-terrorism field training with multiple behavioral measures. *Applied Ergonomics*, *44*(5), 680–686. https://doi.org/10.1016/j.apergo.2012.04.015

Tang, W., Jeon, S.-G., & Choo, S.-G. (2016). How does communication structure influence team performance in complex tasks. *Journal of Digital Convergence*, *14*(4), 221–230. Retrieved from http://kasdba.org/ijictdc/

Tannenbaum, S. I., & Cerasoli, C. P. (2013). Do team and individual debriefs enhance performance? A meta-analysis. *Human Factors*, *55*(1), 231–245. https://doi.org/10.1177/0018720812448394

Thomas, R. M. (2005). *Comparing theories of child development* (6th ed.). Belmont, CA: Thompson Learning.

Townsend, L., Johnston, J., Ross, W. A., Milham, L., Riddle, D., & Phillips, H. (2018). An integrated after action review (IAAR) approach: Conducting AARs for scenario-based training across multiple and distinct skill areas. In D. Harris (Ed.), *Engineering* *psychology and cognitive ergonomics* (pp. 230–240). https://doi.org/10.1007/978-3-319-91122-9_20

Urban, J. M., Bowers, C. A., Monday, S. D., & Morgan, B. B. (1995). Workload, team structure, and communication in team performance. *Military Psychology*, *7*(2), 123-139. https://doi.org/10.1207/s15327876mp0702_6

U.S. Army PEO STRI. (2014). *Squad overmatch study: Training human dimension to enhance performance*. Fort Belvoir, VA: Defense Technical Information Center. https://doi.org/10.21236/ADA613853

U.S. Bureau of Labor Statistics. (2017, February). Military careers: Occupational outlook handbook. Retrieved from https://www.bls.gov/ooh/military/military-careers.htm

U.S. Department of Defense. (2012). *Sustaining U.S. global leadership: Priorities for the 21st century defense*. Retrieved from http://archive.defense.gov/news/Defense_Strategic_Guidance.pdf

U.S. Department of the Army. (2003). *Objective force embedded training* (TRADOC Pamphlet No. 350–37). Fort Monroe, VA: U.S. Army Training and Doctrine Command. Retrieved from http://www.tradoc.army.mil/htm

U.S. Department of the Army. (2008a). *Rifle marksmanship M16-/M4 series weapons* (Field Manual No. FM 3-22-9). Washington, DC: Headquarters DA. Retrieved from http://usacac.army.mil/sites/default/files/misc/doctrine/CDG/cdg_resources/manuals/fm/fm3_22x9.pdf

U.S. Department of the Army. (2008b). *The U.S. Army human dimension concept* (TRADOC Pamphlet No. 525-3–7). Fort Eustis, VA: U.S. Army Training and Doctrine Command. Retrieved from https://adminpubs.tradoc.army.mil/

U.S. Department of the Army. (2012). *The infantry rifle company collective task publication* (Training Circular No. TC 3-21.10). Washington, DC: Headquarters DA. Retrieved from https://armypubs.us.army.mil/doctrine/index.html

U.S. Department of the Army. (2014). *The U.S. Army operating concept: Win in a complex world* (TRADOC Pamphlet No. 525-3–1). Fort Eustis, VA: Training and Doctrine Command. Retrieved from http://www.tradoc.army.mil/tpubs/pams/tp525-3-1.pdf

U.S. Department of the Army. (2015a). *Integrated weapons training strategy* (Training Circular No. TC 3-20.0). Washington, DC: Headquarters DA. Retrieved from https://armypubs.us.army.mil/doctrine/index.html

U.S. Department of the Army. (2015b). *Leader Development* (Field Manual No. FM 6-22). Washington, DC: Center for Army Leadership. Retrieved from http://www.milsci.ucsb.edu/sites/secure.lsit.ucsb.edu.mili.d7/files/sitefiles/fm6_22.pdf

U.S. Department of the Army. (2017a). *Enlisted initial entry training policies and administration* (TRADOC Regulation No. 350–6). Fort Eustis, VA: Training and Doctrine Command. Retrieved from http://www.tradoc.army.mil/tpubs/regs/tr350-6.pdf

U.S. Department of the Army. (2017b). *Multi-Domain battle: Combined arms for the 21st century*. Presented at the Army-Marine Corps White Paper, Fort Leavenworth, KS: U.S. Army Training and Doctrine Command. Retrieved from https://adminpubs.tradoc.army.mil/

U.S. Department of the Army. (2017c). *Multi-domain battle: Evolution of combined arms for the 21st century* (Concept No. 2025–2040). Fort Eustis, VA: Training and Doctrine Command. Retrieved from http://www.tradoc.army.mil/multidomainbattle/docs/MDB_Evolutionfor21st.pdf

U.S. Department of the Army. (2017d). *The U.S. Army learning concept for training and education* (TRADOC Pamphlet No. 525-8–2). Fort Eustis, VA: Training and Doctrine Command. Retrieved from http://adminpubs.tradoc.army.mil/pamphlets/TP525-8-2.pdf

Valdiri, L. A., Andrews-Arce, V. E., & Seery, J. M. (2015). Training forward surgical teams for deployment: The US Army trauma training center. *Critical Care Nurse*, *35*(2), e11–e17. https://doi.org/10.4037/ccn2015752

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist*, *46*(4), 197-221. https://doi.org/10.1080/00461520.2011.611369

Wegner, D. M. (1987). Transactive Memory: A Contemporary Analysis of the Group Mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of Group Behavior* (pp. 185–208). New York, NY: Springer. https://doi.org/10.1007/978-1-4612-4634-3_9

Wegner, D. M., Giuliano, T., & Hertel, P. T. (1985). Cognitive interdependence in close relationships. In W. J. Ickes (Ed.), *Compatible and incompatible relationships* (pp. 253–276). New York, NY: Springer.

Wiese, C. W., Shuffler, M. L., & Salas, E. (2015). Teamwork and team performance measurement. In N. J. Smelser & P. B. Bates (Eds.), *International encyclopedia of the social & behavioral sciences* (pp. 96–103). Amsterdam, Netherlands: Elsevier.

Wildman, J. L., Thayer, A. L., Pavlas, D., Salas, E., Stewart, J. E., & Howse, W. R. (2012). Team knowledge research: Emerging trends and critical needs. *Human Factors*, *54*(1), 84–111. https://doi.org/10.1177/0018720811425365

Wildman, J. L., Salas, E., & Scott, C. P. R. (2014). Measuring cognition in teams: A cross-domain review. *Human Factors*, *56*(5), 911-941. https://doi.org/10.1177/0018720813515907

Xiong, H.-B., & Fang, P. (2014). Authentic leadership, collective efficacy, and group performance: An empirical study in China. *Social Behavior and Personality*, *42*(6), 921-932. https://doi.org/10.2224/sbp.2014.42.6.921

Yin, R. K. (2006). Case study methods. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 111–122). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Yin, R. K. (2015). *Qualitative research from start to finish* (2nd ed.). New York, NY: The Guilford Press.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Los Angeles, CA: SAGE Publications, Inc.

Zajac, S., Gregory, M. E., Bedwell, W. L., Kramer, W. S., & Salas, E. (2014). The cognitive underpinnings of adaptive team performance in ill-defined task situations. *Organizational Psychology Review*, *4*(1), 49–73. https://doi.org/10.1177/2041386613492787

# Appendices

# Appendix A: Data Sharing Agreement

**Background**

A data sharing agreement is a contractual document used for the transfer of non-public data derived from human subject research that is subject to restricted use. This type of agreement serves to outline the terms and conditions of the transfer of the non-public data, to include important issues such as limitations on use of the data, obligations to safeguard the data, liability for harm arising from use of the data, publication and privacy rights associated with the transfer of confidential or protected data.

Although all data being transferred is expected to be non-identifiable, it will initially be treated as if it could contain identifiable private information. This data sharing agreement is study specific, it is for the outgoing transfer of ARL data to a third party who has a bona fide research use or practical application for the data (*e.g.,* collaborating entities, academicians, other governmental organizations). All data being provided under this agreement has been collected in accordance with all applicable Federal and Department of Defense (DoD) research regulations and policies. If incoming data to ARL is proposed, the data provider will determine if a data sharing agreement is necessary.

The ARL Institutional Review Board (IRB) or Human Research Protection Program (HRPP) that had oversight over the original protocol generating the data must be notified if a researcher or institution plans to share data with a recipient (person or entity) not named in the original IRB application. That recipient must sign a data sharing agreement before the data is shared and should consult their institution's IRB/HRPP for their institution's policy on review and oversight for this data. A data sharing agreement is not required if the recipient is named in the original IRB application.

If you have questions about the information above or the need for a data sharing agreement, please consult your institutional compliance or counsel's office.

**ARMY RESEARCH LABORATORY**
**DATA SHARING AGREEMENT**

This Data Sharing Agreement ("Agreement") is entered into by and between Sean Normand ("Recipient") and the Army Research Laboratory ("ARL") (or hereafter known as the "Parties"). This Agreement is effective upon the date of the final signature of both Parties ("Effective Date").

The purpose of this Agreement is to provide Recipient with access to data, either identifiable private information, de-identified data or coded data, which Recipient will use in research as noted below:

For use in the following titled research project: Tactical Combat Casualty Care Training for Readiness and Resilience (also referred to as Squad Overmatch) (Project Name),

Under the direct supervision of Joan H. Johnston (Principal Investigator),

Data Collected Under – IRB Protocol Number(s): ARL16 - 030, and if applicable any associated contract/agreement number _N/A___________________.

Use of the Data: The recipient is using the data to complete a Dissertation requirement at the College of Education & Professional Studies at the University of West Florida, Pensacola, FL.

Access to this data is in accordance with 45 Code of Federal Regulations (CFR) part 46, subpart A (also known as the "Common Rule"), 32 CFR part 219, and Department of Defense Instruction (DoDI) 3216.02 (November 8, 2011).

"Private information", as noted in the Common Rule, includes information about behavior that occurs in a context in which an individual can reasonably expect that no observation or recording is taking place, and information which has been provided for specific purposes by an individual and which the individual can reasonably expect will not be made public (for example, a medical record). Private information must be individually identifiable (*i.e.*, the identity of the subject is or may readily be ascertained by the investigator or associated with the information) in order for the information to constitute research involving human subjects

Non-identifiable data is data that has been stripped of all identifiers such that an investigator cannot readily ascertain a human subject's identity. Examples of identifiers include initials, first and last names, social security number, address, zip code, phone number, gender, age, birth date, occupation, employer, racial or ethnic group, biometric or photographic identifiers or any other unique identifier.

The term coded data means data that has an individual study or identification code which is then linked, through a master code, to private information. ARL holds the master code and only coded data is to be shared under this Agreement.

1. Recipient agrees to:

    a. Establish appropriate administrative, technical and physical safeguards to protect the confidentiality of the data as necessary and to prevent unauthorized use or access to it;

    b. Report to ARL within 24 hours of which it becomes aware, any use or disclosure of data not permitted by this Agreement, including data breach and/or the presence of prohibited identifiers in the data;

    c. Use the data only as permitted by this Agreement;

    d. Notify and obtain approval from ARL, as documented in an "Additional Use Addendum" to this Agreement prior to use of the data for other purposes except as described in this Agreement;

    e. Initiate and obtain an IRB approved protocol for use of the data, as well as any other IRB approved additional use of the data;

    f. Implement appropriate handling and storage requirements necessary for the use of the data;

    g. Use appropriate safeguards, operating procedures and security measures to prevent use or disclosure of the data other than as permitted by this Agreement;

    h. Provide a data management plan if requested by ARL

    i. Place appropriate confidentiality markings on the data and any derivative data;

    j. Keep the data intact, with no copies or derivatives of the data made without prior written approval of ARL;

    k. Require any of its subcontractors, subrecipients or agents that receive or have access to the data to agree to the same restrictions and conditions on the use and/or disclosure of the data that apply to Recipient under this Agreement;

    l. Provide an advance copy, 30 calendar days prior to publication or other disclosure, of the results of the research using the data provided under this Agreement.

    m. Disallow the use of the information in the data, alone or in combination, to identify or contact the individuals who are data subjects.

n. Destroy the data, including any identifiers or metadata, when the identifiers are no longer required for the purpose for which the data was provided under this Agreement or upon termination of this Agreement and provide signed and dated certification of the destruction document to ARL.

2. Points of Contact.

ARL:

POC Name: Joan H. Johnston

Telephone: 407.384.3980

Email: joan.h.johnston.civ@mail.mil

RECIPIENT:

POC Name: Sean Normand

Telephone: 850.339.5086

Email: sn30@students.uwf.edu

3. Term and Termination.

a. The term of this Agreement shall commence as of the Effective Date and terminate upon the completion of the research project or 5 years from the Effective Date, whichever occurs first. Should the Recipient desire to keep the data for a longer period, a justification in writing must be provided to the ARL POC 90 calendar days prior to the termination of this Agreement.

b. Recipient may terminate this Agreement at any time by notifying the ARL POC and destroying the data. ARL may terminate this Agreement at any time by providing thirty (30) calendar days prior written notice to Recipient, unless the termination is due to non-compliance by the Recipient of the terms of this Agreement which will result in immediate termination.

c. This Agreement is subject to review at any time upon written request by either Party.

4. Miscellaneous.

a. The Parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both Parties' obligations under this Agreement. If the Parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in Section 3.

b. The Parties mutually agree that ARL retains all ownership rights to the original data referred to in this Agreement. The Recipient is not given any rights, titles, or interest to any of the data provided by ARL. The Recipient also agrees they will in no way disclose, release, reveal, show, sell, rent, lease, loan or otherwise grant access to this data except as authorized under this Agreement.

c. Data provided under this Agreement will be transmitted in an encrypted format as necessary.

d. ARL shall have the right, at any time, to monitor, audit and review activities and methods implementing this Agreement to ensure compliance with this Agreement.

e. The Recipient agrees to release and hold harmless the United States of America, its officers and its agents, from any and all claims, costs, charges, demands and liabilities arising from the Recipient's receipt, management and use of data pursuant to this Agreement.

f. ARL assumes no responsibility for the accuracy or integrity of data provided to Recipient under this Agreement, or for accuracy or integrity of the data once the Recipient alters or modifies the data. ARL assumes no responsibility for the accuracy or validity of published or unpublished conclusions based in whole or in part on analyses of the data provided to the Recipient.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

| **ARMY RESEARCH LABORATORY** | **RECIPIENT** |
| --- | --- |
| JOHNSTON.JOAN.HALL.1228727624 Digitally signed by JOHNSTON.JOAN.HALL.1228727624 Date: 2018.08.16 07:51:43 -04'00' By: ______ | By: ______ |
| Print Name: Joan H. Johnston | Print Name: Sean Normand |
| Print Title: Senior Scientist | Print Title: Program Manager |

# Appendix B: Letter of Approval

Joan H. Johnston
Senior Scientist
Natick Soldier Research, Engineering, and Development Center (NSRDEC)
Simulation and Training Technology Center
12423 Research Parkway
Orlando, FL 32826
407.384.3980

13 August 2018

RE: Approval for Mr. Sean Normand to use the human participant research data collected during the U.S. Army Research Laboratory study titled: Tactical Combat Casualty Care Training for Readiness and Resilience (also referred to as Squad Overmatch)

Dr. Ludmila Cosio Lima:

I am the Principal Investigator for a U.S. Army Research Laboratory project titled: Tactical Combat Casualty Care Training for Readiness and Resilience. The ARL IRB identification code designation is ARL 16-030. The project was approved by the ARL IRB Panel on 12 April 2016. Mr. Sean Normand is listed as one of the Engaged Personnel on the protocol. The human participant data collection was conducted from May through June 2016. The protocol received a continuation approval 18 January 2018 to continue analysis of the participant data. The continuation approval ends 19 January 2019 wherein a new continuation will be requested if necessary. I have given Mr. Normand full access to the data collected (survey data, videos, and audiotape) for his dissertation study.

Respectfully,

JOHNSTON.JOAN.HALL.1228727624 Digitally signed by JOHNSTON.JOAN.HALL.1228727624 Date: 2018.08.13 10:29:56 -04'00'

Joan H. Johnston

## Appendix C: Behavioral Marker Data Collection Sheet

| **Team Cohesion** | **Frequency Observed AAR** | **Frequency Observed Mission** |
|---|---|---|
| Soldiers actively work together and take initiative to reach squad objectives/goals | | |
| Soldiers do not actively work together or take initiative to reach squad objectives/goals | | |
| | | |
| Soldiers contribute to discussions (TL to SL or SL to PL) about new courses of action/problem solving | | |
| Soldiers do not contribute to discussions (TL to SL or SL to PL) about new course of action/problem solving or were dismissive of soldiers who did | | |
| | | |
| Soldiers take responsibility for mistakes when they occur | | |
| Soldiers do not own up to mistakes when they occur | | |
| | | |
| Soldiers value squad member contributions during AARs/ mission; seek input from the entire squad | | |
| Soldiers do not value member contributions during AARs/ mission, or were dismissive of other squad member input | | |

| | | |
|---|---|---|
| Soldiers make positive affirmations toward the squad's work | | |
| Soldiers make negative affirmation like "this sucks", "you suck", "why did you do that"; toward the squad's work | | |

| **Collective Efficacy** | **Frequency Observed AAR** | **Frequency Observed Mission** |
|---|---|---|
| Soldiers express confidence in squad task completion | | |
| Soldiers express doubt or fear of failure regarding squad task completion | | |
| | | |
| Soldiers rely on squad members for assistance | | |
| Soldiers rely on non-squad members (i.e., third party) for assistance | | |
| | | |
| Soldiers cooperate and avoid unproductive conflict regarding task completion. | | |
| Soldiers do not cooperate and engage in unproductive conflict regarding task completion. | | |
| | | |
| Soldiers express confidence regarding conflict resolution and squad priorities and/or objectives (e.g., “Let’s do this!") | | |
| Soldiers express doubt regarding conflict resolution and squad priorities and/or objectives (e.g.," Let's just get this over with") | | |

| | | |
|---|---|---|
| Soldiers manage interpersonal tact while communicating squad priorities and/or objectives. | | |
| Soldiers do not manage interpersonal tact while communicating squad priorities and/or objectives. | | |

# Appendix D: Subject Matter Expert Performance Rating Measurement Guideline

| Poor Performance | Average Performance | Proficient Performance |
|---|---|---|
| The Team performed this task poorly. The Team conducted one or more significant tactical errors in executing this task. | The Team performed this task to standard. The Team conducted one or more moderate tactical errors in executing this task but no significant tactical errors. | The Team performed this task to proficiently. The Team may have conducted one or more minor tactical errors in executing this task but no moderate tactical errors. |

| Extremely Poor Performance | Poor Performance | Below Average Performance | Average Performance | Above Average Performance | Proficient Performance | Extremely Proficient Performance |
|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |

- Significant tactical errors may lead to the loss of life, serious bodily harm, or failure to complete the task
- Moderate tactical errors negatively impact task execution or place the Team in a tactical disadvantage
- Minor tactical errors are instances where tactical execution could be improved but do not negatively impact completion of the task or place the Team at a tactical disadvantage.

| Task | Description | Rating |
|---|---|---|
| Treat Casualties | Unit medical personnel/combat lifesavers fail to perform enhanced first aid treatment contributing to noncombatant or unit soldier loss of life or serious bodily harm. | 0 |
| Conduct Action on Contact | The team leader/squad leader did not select an appropriate course of action based on the commander's intent, which contributed to one or more soldier casualties | 1 |
| Enter and Clear a Building | The unit entered the building to establish a foothold | 3 |
| Enter and Clear a Building | The unit controlled noncombatants, contraband, equipment, and secured items. | 3 |
| Conduct Action on Contact | The team leader/squad leader efficiently directed the unit to execute selected COA based on the situation or leader's order using radio, voice or other tactical means of communication | 5 |
| Treat Casualties | Unit medical personnel/combat lifesavers successfully evaluate, treat, and evacuate casualties to supporting medical element resulting in the preservation of life. | 6 |

## Appendix E: Task Checklist Supplement Sheet

| Task | Checklist Supplement Sheet |
| --- | --- |
| Action on Contact | 1. Unit leaders gained and/or maintained situational understanding. |
| Action on Contact | 5. The element in contact deployed and reported. |
| Action on Contact | 6. The unit complied with ROE. |
| Action on Contact | 7. The unit leader evaluated the situation. |
| Action on Contact | 9. The unit leader selected an appropriate course of action based on the commander's intent. |
| Action on Contact | 10. The unit leader recommended alternative COA. |
| Action on Contact | 11. The unit leader directed the unit to execute the COA based on the situation or leader's order using FBCB2, FM, or other tactical means. |
| Action on Contact | 12. The unit leader or designated representative kept the higher command informed throughout the operation using FBCB2, FM, or other tactical means. |
| Action on Contact | 13. The unit conducted consolidation and reorganization. |
| Action on Contact | 14. Unit continued mission as directed. |
| Establish an OP | 1. Unit leaders gained and/or maintained situational understanding. |
| Establish an OP | 5. The unit leader developed a tentative plan. |
| Establish an OP | 10. The unit moved to and conducted a hasty occupation of the OP. |
| Establish an OP | 11. The unit constructed the OP. |
| Establish an OP | 12. The unit leader organized operations. |
| Establish an OP | 13. The unit conducted OP operations. |
| Establish an OP | 14. Unit leader provided SITREPs to higher HQs and continued mission as directed. |
| Treat Casualties | 1. Commander and leaders supervise first aid treatment of casualties. |
| Treat Casualties | 2. Unit personnel perform first aid treatment. |
| Treat Casualties | 3. Unit medical personnel/combat lifesavers perform enhanced first aid treatment. |
| Treat Casualties | 4. Unit medical personnel/combat lifesavers evacuate casualties to supporting medical element. |
| | |

| | |
| --- | --- |
| Tactical Movement | 1. Unit leaders gained and or maintained situational understanding. |
| Tactical Movement | 7. Unit leader disseminated all pertinent information. |
| Tactical Movement | 9. Unit leader coordinated / synchronized actions of subordinate elements. |
| Tactical Movement | 10. Unit moved using movement fundamentals. |
| Tactical Movement | 11. Unit moved using the appropriate formation. |
| Tactical Movement | 12. Unit executed movement techniques. |
| Tactical Movement | 13. Unit leader positioned himself where he could best control and execute the desired formation. |
| Tactical Movement | 14. Unit maintained formation with correct interval, speed, and or lateral dispersion. |
| Tactical Movement | 15. Unit oriented weapons/weapon systems to provide security and maximize firepower as necessary. |
| Tactical Movement | 16. Unit reacted to hostile contact as appropriate. |
| Tactical Movement | 17. Unit moved undetected to the designated point. |
| Tactical Movement | 18. Unit consolidated and reorganized as necessary. |
| Tactical Movement | 19. Unit continued operations. |
| Conduct Negotiations | 1. Unit leaders gained and/or maintained situational understanding. |
| Conduct Negotiations | 6. Unit secured and prepared the meeting location. |
| Conduct Negotiations | 7. Unit negotiation team conducted negotiations |
| Conduct Negotiations | 8. Unit negotiation team leader prepared and reported negotiation results. |
| Cordon and Search | 1. Unit leaders gained and or maintained situational understanding. |
| Cordon and Search | 4. Unit leader issued clear and concise orders, instructions, and tasking. |
| Cordon and Search | 7. Unit leader coordinated/synchronized actions. |
| Cordon and Search | 9. Unit elements moved to the area to be searched. |
| Cordon and Search | 10. Cordon element established cordon. |
| Cordon and Search | 11. Search element conducted the search. |
| Cordon and Search | 12. Unit leader controlled the unit's rate of search and directed reorganization. |
| Cordon and Search | 13. Unit consolidates and reorganizes as necessary. |
| Cordon and Search | 14. Unit continued operations. |
| | |

| | |
|---|---|
| Enter and Clear a Building | 1. Unit leaders gained and/or maintained situational understanding. |
| Enter and Clear a Building | 7. The unit leader issued any updates or adjustments to his FRAGORD as necessary to address changes to the plan identified during the rehearsal. |
| Enter and Clear a Building | 8. The unit conducted tactical movement to the building. |
| Enter and Clear a Building | 9. The unit leader selected the method to enter the building |
| Enter and Clear a Building | 12. Unit conducted breach of entry point. |
| Enter and Clear a Building | 13. The clearing element entered the building to establish a foothold. |
| Enter and Clear a Building | 14. The unit conducted deliberate clearance of the building. |
| Enter and Clear a Building | 15. The unit controlled noncombatants, contraband, equipment and secured items. |
| Enter and Clear a Building | 16. Once the building is secured, the unit conducted a deliberate search of the building. |
| Enter and Clear a Building | 17. The unit consolidated and reorganized as necessary. |
| Enter and Clear a Building | 18. The unit continued operations as directed. |
| Evacuate Casualties | 1. Commander and leaders supervise evacuation of casualties. |
| Evacuate Casualties | 2. Unit personnel prepare casualties for evacuation. |
| Evacuate Casualties | 3. Unit personnel evacuate casualties to casualty collection points using manual carries. |
| Evacuate Casualties | 4. Unit personnel evacuate casualties to casualty collection points using litter carries. |
| Evacuate Casualties | 5. Unit personnel evacuate casualties to a medical treatment facility (MTF) using available vehicles. |
| Evacuate Casualties | 6. Commander and leaders request aeromedical evacuation. |
| Evacuate Casualties | 7. Unit personnel assist in loading ambulance. |
| Evacuate Casualties | 8. Unit personnel evacuate chemically contaminated casualties. |
| Evacuate Casualties | 9. Unit personnel evacuate EPW casualties. |
| Conduct TLPs | 3. Step 3 - Made a tentative plan. Unit leaders developed a tentative plan. |
| Conduct TLPs | 4. Step 4 - The unit initiated movement. |
| Conduct TLPs | 5. Step 5 - Conducted Reconnaissance. The unit conducted reconnaissance required by commander to seek or confirm information requirements. |
| Conduct TLPs | 8. Step 8 - Supervised and refined the plan. The leader monitored mission preparations, refined the plan, coordinated with adjacent units, and supervised and assessed preparations. |

# Appendix F: IRB Approval

University of West Florida

Research and Sponsored Programs
11000 University Parkway, Bldg. 11
Pensacola, FL 32514-5750

Mr. Sean Normand October 11, 2018

Dear Mr. Normand:

The Institutional Review Board (IRB) for Human Research Participants Protection has completed its review of your proposal number IRB 2019-026 titled, "Teamwork and Task-work in the U.S. Army: How teams address outcomes and processes during performance reviews," as it relates to the protection of human participants used in research, and granted approval for you to proceed with your study on 10-08-2018. As a research investigator, please be aware of the following:

* You will immediately report to the IRB any injuries or other unanticipated problems involving risks to human participants.

* You acknowledge and accept your responsibility for protecting the rights and welfare of human research participants and for complying with all parts of 45 CFR Part 46, the UWF IRB Policy and Procedures, and the decisions of the IRB. You may view these documents on the Research and Sponsored Programs web page at http://research.uwf.edu. You acknowledge completion of the IRB ethical training requirements for researchers as attested in the IRB application.

* You will ensure that legally effective informed consent is obtained and documented. If written consent is required, the consent form must be signed by the participant or the participant's legally authorized representative. A copy is to be given to the person signing the form and a copy kept for your file.

* You will promptly report any proposed changes in previously approved human participant research activities to Research and Sponsored Programs. The proposed changes will not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the participants.

* **You are responsible for reporting progress of approved research to Research and Sponsored Programs at the end of the project period 06-30-2019. If the data phase of your project continues beyond the approved end date, you must receive an extension approval from the IRB.**

* If using electronic communication for your study, you will first obtain approval from the authority listed on the following web page: https://uwf.edu/offices/institutional-communications/resources/broadcast-distribution-standards/.

Good luck in your research endeavors. If you have any questions or need assistance, please contact Research and Sponsored Programs at 850-474-2824 or 850-474-2609 or irb@uwf.edu.

Sincerely,

Dr. Matthew Schwartz, Assistant Vice President for Research and
Interim Assistant Vice President
Research Administration

Dr. Carla Thompson, Chair, IRB for
Human Research Participant Protection