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Effects of chemical protective equipment on team process performance in small unit rescue operations

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Abstract

In the event of a nuclear, biological, or chemical terrorist attack against civilians, both military and civilian emergency response teams must be able to respond and operate efficiently while wearing protective equipment. Chemical protective equipment protects the user by providing a barrier between the individual and hazardous environment. Unfortunately, the same equipment that is designed to support the user can potentially cause heat stress, reduced task efficiency, and reduced range-of-motion. Targeted Acceptable Responses to Generated Events of Tasks (TARGETS), an event-based team performance measurement methodology was used to investigate the effects of Mission Oriented Protective Posture (MOPP) on the behavioral processes underlying team performance during simulated rescue tasks. In addition, this study determined which team processes were related to team performance outcomes. Results of six primary analyses indicated that team process performance was not degraded by MOPP 4 on any rescue task and that the team processes critical for successful task performance are task-dependent. This article discusses the implications of these results with respect to the study design and the limitations of using an event-based team performance measurement methodology.

Keywords: Team performance; MOPP; Personal protective equipment; TARGETS

1. Introduction

1.1. Background

Soldiers have been threatened with nuclear, biological and chemical (NBC) weapons since World War I; however, more recent threats of terrorism (and the potential use of biological or chemical weapons or "dirty bombs") against civilians will require both military and civilian emergency response teams to operate efficiently in response to an NBC attack. As such, we must understand any potentially degrading effects that chemical protective equipment may have on a team's ability to communicate, coordinate, and adapt to rapidly changing events (i.e., team processes). This knowledge is vital to the safety of millions of people across the globe, not just in the United States. Performance prediction, assessment and training can be improved for a variety of potentially affected teams including fire-fighting teams, chemical disaster clean-up teams, and hazardous material handling teams.

This study assessed the extent to which Mission Oriented Protective Posture (MOPP) equipment, the US military's chemical protective equipment, degraded team processes of two-person emergency medical technician (EMT) teams during simulated rescue scenarios. Past research indicated that MOPP degraded individual soldier performance during field exercises, maintenance tasks, and target detection tasks (Draper and Lombardi, 1986; Cox et al., 1981; Johnson, 1991); however, the effects were only seen in terms of increased task completion time. The effect of MOPP on the behavioral processes involved in team performance was not evaluated.

A series of studies by Morrissey and Wick (1989) investigated the degrading effects of MOPP on team performance outcomes (i.e., summed task completion time) on several military tasks. They identified MOPP as a critical team performance factor in four types of

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tasks—visual, fine motor discrete (FMD), gross motor light (GML), and communication. Morrissey and Wick's (1989) research was an important step in protective clothing research because it provided a more detailed understanding of the nature of performance degradation and extended the research to include teams. However, these studies did not explicitly include measures of team process (e.g., communication, coordination, etc.). Thus, this study assessed team process behaviors in addition to performance outcomes to gain a new perspective into the effects of chemical protective clothing on team performance.

1.2. Teams versus individuals

There are many definitions of a team in the existing team performance literature. Although authors use different terms, there is a general consensus among researchers of what constitutes a "team" versus a "nominal group," or group in name only. The most widely accepted definitions and characteristics of teams are summarized here. Nieva et al. (1978, p. 51) defined a team as "two or more interdependent individuals performing coordinated tasks toward the achievement of specific task goals". The authors emphasized the two defining characteristics of a team (versus a nominal group) are a task orientation shared by all team members and the interdependence of team members. This interdependence implies there is a requirement for coordination and interaction among team members that is not required for individuals in nominal groups. Glaser et al. (1962) also differentiated between nominal groups and teams based on two characteristics. First, nominal groups do not have a rigid or well-defined structure, organization, or communication pattern whereas teams do. Second, group members assume roles during the course of group interaction rather than being initially assigned to a role as is the case for teams.

Teams differ from individuals because teams require synchronized behavior in order to reach a common goal. Team members must possess special skills and knowledge and provide and receive feedback in order to operate effectively. When a team fails, it is not necessarily because one member failed to meet the requirements; it is likely because the team could not coordinate the contributions of each team member. Conversely, the dynamics of team performance allow for a team to produce a successful outcome without success by each individual member of the team (Brannick et al., 1991).

For the purposes of this study, participants were considered to constitute teams rather than nominal groups. This distinction is based on the definitions provided previously which differentiated teams from nominal groups. The nature of the rescue tasks used in this study required that team members be interdependent. The rescue tasks required coordinated two-person tasks that could not be completed by an individual. Team members shared the same task orientation as a result of both EMT training and certification as well as the pre-study briefing and pre-rescue summaries. Specific roles were assigned prior to the beginning of the experiment and all team members received the same EMT training. The nature of the tasks required team members to provide and receive feedback about the surrounding environment, the victim's condition, and the rescue procedure. The ability of the team to coordinate actions determined their success during the rescue scenarios. These defining characteristics are accounted for in the experimental setup, providing a legitimate basis for measuring team rather than nominal group performance.

1.3. Outcome versus process evaluation

Team performance measurement techniques can take two approaches—outcome measurement and process measurement. Outcome measurements (e.g., completion time, errors, accuracy) focus on the ultimate results of the team's actions whereas process measurements (e.g., decision making, communication, coordination) focus on *how* the tasks are accomplished (Paris et al., 1999).

Using a process-oriented approach, Morgan et al. (1986) developed the Critical Team Behaviors Form (CTBF) determine the relationship between teamwork skills and task work and to measure teamwork skills in US Navy teams. They found that coordination, communication, and adaptability were the key determinants between teams that performed well and teams that performed poorly (Morgan et al., 1986). Other behaviorally based teamwork measurement techniques were developed based on this system and adapted for the performance measurement of various types of teams (Fowlkes et al., 1994; Stout et al., 1994; Brannick et al., 1995). Often, the process behaviors that were important in one study were not important or relevant in another study simply because the task did not demand the use of that particular team process. Thus, it appears that critical team performance processes are task-dependent. As a result, it is imperative that researchers be cautious about generalizing results of team process performance studies across different tasks.

Behaviorally based team process measurement systems such as the CTBF rely heavily on observer ratings to identify critical team processes and rate team performance. In contrast, Fowlkes et al. (1994) developed an event-based measurement methodology called Targeted Acceptable Responses to Generated Events of Tasks (TARGETs) to measure team process performance. As a general rule, scenario scripts are written to ensure that team processes are cued throughout a task. TARGETs then uses observers to record the presence or absence (a "hit" or "miss", respectively) of scripted behaviors. The technique minimizes observer judgment by using a standardized checklist of appropriate responses. An overall team performance score can be obtained by determining the overall proportion of "hits" to "misses." The TARGETs methodology can be adapted for many tasks and permits analysis of multiple team processes.