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An Analysis of Squad Communication Behaviors during a Field-Training Exercise to Support Tactical Decision Making

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ABSTRACT

Understanding how teams function in dynamic environments is critical for advancing theories of team development. In this paper, we compared communication behaviors of high and low performing U.S. Army squads that completed a field training event designed to assess tactical decision-making skills and performance under stress. Transcribed audio logs of U.S. Army squad communications were analyzed. A series of 2 (performance group) by 2 (time: Pre-Contact and Post-Contact) mixed-model ANOVAs were conducted to determine whether team communication behaviors changed for squads after coming under duress from hostile contact. Significant main effects for time were found for several communication labels indicating communication patterns differed as task complexity and stressors increased. Significant interaction effects were found between time and performance group for the number of commands given by squad leaders and overall speech frequency. Results highlight the value of examining communications at a granular level as adaptive patterns may otherwise be overlooked.

Keywords: Team communication, Team effectiveness, Field training

INTRODUCTION

Team communication has been recognized as a critical component of team performance for nearly six decades (Goodwin et al., 2018). Numerous studies have shown that effective teams share appropriate information with team members at the appropriate time to facilitate team performance, promote adaptability, and improve team coordination. Research also shows the type of team activity, team size, structure, and stress or demand level can each impact team communication behaviors (Tiferes and Bisantz, 2018). By studying how teams communicate and function in dynamic, real-world environments, researchers gain critical insights about the processes teams use to collaborate and coordinate, and this data is essential for advancing theories of team development.

Research examining team communicating has often focused on team communication in action teams, or groups of experts carrying out complementary roles in complex, high-stakes, time-limited performance events (Sundstrom et al., 2000). Notable action teams studied have included military teams and squads, surgical teams, air-traffic controllers, pilots, and more (Marlow et al., 2018). For instance, Entin and Serfaty (1999) examined military team communication in the context of a simulated anti-air warfare mission for naval officers and found that highly effective teams shared information adapted to high workload situations more effectively than low performing teams.

Increasingly complex environments such as those that action teams face demand effective communication as a mechanism for distributing needed information without error and for continuously updating a team's shared mental model (Salas et al., 2005). In a meta-analysis conducted by Mesmer-Magnus and DeChurch (2009), information exchange within teams was found to be a consistent driver of performance. One of the most common approaches for studying information exchange involves examining communication content and patterns of communication within teams. When data on team performance are available, researchers have applied quantitative methods to analyze frequency or sequencing of communication patterns within teams to identify behaviors of teams exhibiting high levels of performance (Nonose et al., 2015). For example, prior work examining crew coordination and communication during simulated flights showed that high performing teams had lower proportions of non-task-related communications compared to lower performing teams (Bowers et al., 1998). A numerical index known as an *anticipation ratio* has also been found to relate to team performance (Gontar et al., 2017; Nonose et al., 2015) whereby a numerical proportion represents how often team members "push" information to each other as compared to how often they have to "pull" information via requests (Serfaty et al., 1998).

Current Study

The dynamic nature of team processes such as communication makes accurate measurement for real-world teams difficult. Given the criticality of understanding and measurement of effective team processes especially in high-stakes environments, simulations can be utilized to elicit specific psychological characteristics of interest (Goodwin et al., 2018). Through high-fidelity synthetic environments, which include not just virtual worlds (e.g., Kozlowski et al., 2016) but also live-training (e.g., Johnston et al., 2019), specific experiences can be designed to elicit and subsequently measure psychological phenomena of interest. As a result, team science researchers have called for both an increase in examinations of real-world teams, but also analyzing team communication behaviors as they relate to team performance at a more granular level.

To address these needs, this research explores team communication behavior data collected during the Squad Overmatch project, designed for U.S. Army squads to improve decision-making under stress through scenario-based training (Johnston et al., 2019). Six squads completed one virtual

event (M1) and two live training events (M2 and M3). Prior to training events, a quasi-experimental design was used to assign three squads to additional teamwork, stress exposure, and tactical combat casualty care training, while the three remaining squads in a control condition received standard tactical training. Audio recordings were gathered during the live training event, and trained behavioral observers completed a series of dichotomous rating checklists to assess the completion of specific behaviors during predefined episodes elicited by the training scenario. Squad communications were recorded and transcribed, and a "team dimensions" label scheme was applied to capture how information and coordination was shared and requested within squads. Our analyses focused on examining how information exchange related to team performance ratings, as well as whether communication patterns differed between high and low performing squads during the mission.

METHODOLOGY

Dataset

To investigate squad communication behaviors, we utilized transcripts of spoken dialogue from the platoon leader, squad leader, and team leaders captured from the first live training event, titled "Mission 2" of the Squad Overmatch project (Johnston et al., 2019). Six U.S. Army squads participated in the 45-minute live training, where each squad included 8 to 10 members with two team leaders and one squad leader. Each squad was tasked with conducting a reconnaissance mission in a village environment, interfacing with key leaders in the village, and responding to a kinetic event involving hostile gunfire and simulated casualties. Events within the training were designed to elicit specific team development behaviors at key time points, allowing expert observers to record behavioral performance ratings. The events within the mission were designed to introduce greater levels of task complexity and stressors as the mission progressed.

Team Dimension Labels

A total of 6427 utterances were transcribed from the live training mission. Of these, 3745 utterances were labeled using a framework of 18 team dimension labels designed to capture how different types of information and coordination statements and requests were exchanged up and down the chain of command (CoC). The five most frequently occurring team dimension labels correspond to individuals providing information to their subordinates (*provide info down*) and to their superiors (*provide info up*), requesting information from their subordinates (*request info down*), as well as action requests (*commands*) given by squad leaders and team leaders, which are always directed to subordinates.

Anticipation Ratios

Anticipation ratios were calculated by dividing the sum of team dimension labels that reflect squad members "pushing" information by the sum of

team dimension labels that reflect squads "pulling" information. This resulted in a numerical proportion for each squad, whereby a value lower than 1.0 would represent more information being asked for than shared, and a value higher than 1.0 representing more information being shared than asked for. As greater anticipation ratios have previously been demonstrated to be related to teams of high performance, we predicted this would hold true in our data via correlating anticipation ratios with raw performance scores as well as an independent sample t-test between high and low performing teams.

Team Performance Ratings

To investigate whether team communication behaviors were related to team performance, we utilized team performance ratings captured during the Squad Overmatch study. Team performance ratings were provided by subject matter experts who acted as behavioral observers of squads during the training event. Observers used behavioral checklists to assess squads' advanced situation awareness, teamwork, and tactical combat casualty care skills during the mission. Observers provided dichotomous ratings (0/1) to signify whether each behavioral marker was observed within a squad. To assess overall squad coordination and communication performance, we created a single behavioral checklist of advanced situation awareness, which reflected communicating critical information within the squad, and teamwork behaviors, which reflected instances of exchanging information, providing backup behaviors, and collaboration. Each squad was assigned a score based on percentage of completed behaviors.

Data Analysis

To explore patterns of communication behaviors between high and low performing squads, we conducted a median split based on team performance scores. This resulted in squads being labeled as either low ($n = 3$) or high ($n = 3$) performing. We also investigated whether team communication behaviors changed over the course of the training mission. Specifically, we created two conditions, Pre-Contact and Post-Contact, that reflected periods of reduced and enhanced task demands centered around a kinetic event of hostile gunfire. Frequencies of team dimension labels and anticipation ratios during each period were examined for each squad and the top 10 most frequently occurring labels were selected for inclusion in analyses. To account for different squads spending unequal amounts of time in the Pre-Contact and Post-Contact time periods, we calculated the frequency-per-minute of each team dimension label during the two time periods. We then performed a series of 2 (performance group) by 2 (time: Pre-Contact and Post-Contact) mixed-model ANOVAs using communication label frequency-per-minute and anticipation ratios as the dependent variables to explore if the kinetic event moderated team communication behaviors among high and low performing squads.

Table 1. Means and standard deviations for team dimension labels as a function of time and performance group.

	Pre-Contact		Post-Contact	
Team Dimension Labels	**Low Performance** *M(SD)*	**High Performance** *M(SD)*	**Low Performance** *M(SD)*	**High Performance** *M(SD)*
Command:Squad Leader	1.40(0.26)	1.80(0.26)	3.34(0.21)	2.22(0.27)
Provide Info Up CoC	1.28(0.43)	1.43(0.57)	3.75(1.42)	4.92(1.28)
Request Info Down CoC	1.03(0.28)	1.10(0.51)	3.48(1.16)	2.65(0.38)
Total Communication Labels	7.040(1.49)	10.86(1.59)	13.72(3.91)	12.56(2.45)

Note. CoC, *M*, and *SD* represent chain of command, mean, and standard deviation, respectively.

RESULTS

Results revealed a significant correlation between squad anticipation ratio and team performance ratings ($r = .932$, $p = .007$). A follow-up independent-samples t-test was then conducted on the overall anticipation ratio variable between high ($M = 2.73$, $SD = 0.26$) and low ($M = 2.36$, $SD = 0.32$) performance squads, but the effect was not statistically significant $t(4) = -1.54$, $p = .10$. Thus, our first hypothesis was only partially supported.

Next, a series of 2 (performance group) by 2 (time: Pre-Contact and Post-Contact) mixed-model ANOVAs were conducted using communication label frequency and anticipation ratios as the dependent variables to explore if team communication behaviors may have changed for squads of varying performance after coming under duress from enemy contact. Means and standard deviations are reported in Table 1.

Results revealed a significant main effect of time on frequency-per-minute of commands given by squad leaders, $F(1, 3) = 46.72$, $p = .002$, information provided up the chain of command, $F(1, 3) = 50.413$, $p = .002$, information requested from subordinates, $F(1) = 58.73$, $p = .002$, and overall communication, $F(1, 3) = 22.62$, $p = .009$ (see Table 2). Following a kinetic event, squads exhibited more frequent commands from the squad leader, information being provided up the chain of command, information requested from subordinates, and overall communication compared to just before the kinetic event.

Significant interaction effects were also found between time and performance group for the number of commands given by squad leaders, $F(1, 3) = 19.21$, $p = .012$, and total communication within the squad, $F(1, 3) = 8.004$, $p = .047$. Follow-up simple effects analyses revealed that before the kinetic event there were more overall communications per minute for squads of high performance ($M = 10.86$, $SD = 1.59$) than low performance ($M = 7.04$, $SD = 1.49$), $F(1, 3) = 9.19$, $p = .04$. In contrast, following the kinetic event squad leaders in low performing teams provided more commands per

Table 2. Effects of contact event and performance group on team dimension label frequencies.

Command: Squad Leader	Type III SS	MS	*F*	df	partial η^2
Time	4.19	4.19	46.72**	1	0.92
Time x Performance Group	1.72	1.72	19.21*	1	0.83
Error (Time)	.36	.09	–	4	–
Provide Info Up CoC					
Time	*26.65*	*26.65*	*50.41***	1	0.93
Time x Performance Group	0.77	0.77	1.46	1	0.27
Error (Time)	2.12	0.53	–	4	–
Request Info Down CoC					
Time	*12.01*	*12.01*	*58.73***	*1*	*0.94*
Time x Performance Group	*0.61*	*0.61*	*2.97*	*1*	*0.43*
Error (Time)	*0.82*	*0.21*	–	*4*	–
Total Communication Labels					
Time	52.71	52.71	22.62**	1	0.85
Time x Performance Group	18.66	18.66	8.00*	1	0.67
Error (Time)	9.32	2.33	–	4	–

*Note: *p <.05. **p<.01.* CoC represents chain of command.

minute, ($M = 10.86$, $SD = 1.59$) compared to high performing teams ($M = 7.04$, $SD = 1.49$), $F(1, 3) = 9.19$, $p = .04$.

DISCUSSION

The goal of this paper was to examine differences in communication between high and low performing squads and explore how communication behaviors changed over the course of a field training event. Results showed squad anticipation ratios were significantly correlated with overall squad performance scores. Additional results showed that while higher performing squads had higher anticipation ratios, this difference was not statistically significant. One explanation for these findings is that, given the small sample size of this study, there is variance being lost when squads are categorized and unique performance scores are aggregated. The results of the mixed-model ANOVAs present both practical findings and methodological considerations for future research. Results show that as task demands and situational stressors increased team communication behaviors changed. Notably, squad leaders gave commands more frequently; and squads provided more information up the chain of command, requested information from subordinates more frequently, and exhibited a greater proportion of overall communication after the kinetic event compared to prior to the event.

Results also revealed a significant interaction between time and performance group on frequency of commands given by squad leaders and overall communication frequency. Specifically, high performing squads maintained a consistent rate of communication before and after the kinetic training event whereas low performing squads significantly increased their communication following the event. These patterns are consistent with prior work that suggest that higher performing teams might be using communication more

efficiently during times of increased situational stressors than squads exhibiting lower levels of performance (Entin and Serfaty, 1999). These results highlight a critical need for team researchers to consider how dynamic elements within an otherwise singular performance period may have cascading effects on team behaviors, especially in how team members communicate with each other.

A limitation of this study was the small sample size of available teams. While this is largely a representative artifact of field-based team research, it does create limitations on the generalizability of conclusions. Future research should explore how communication within squad fire teams change over time as well as explore behaviors using a larger dataset. Finally, we echo calls from researchers (Tiferes and Bisantz, 2018; Saville et al., 2021) to apply granular approaches when possible while examining team communication alongside performance data.

CONCLUSION

Examining team communication is essential for furthering theories of team development. Results from this investigation provide insight into communication patterns exhibited by high performing teams, as well as how situational stress impacts team communications. Because military missions continue to rely heavily on small, dismounted units, understanding how teams communicate and share information is essential for determining the processes that impact small unit performance.

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