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## **Planning, Shared Mental Models, and Coordinated Performance: An Empirical Link Is Established**

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Critical decisions are made every day by teams of individuals who must coordinate their activities to achieve effectiveness. Researchers recently suggested that a shared mental model (SMM) among team members may help them to make successful decisions. Several avenues for developing SMMs in teams exist, one of which is planning. We explored the relationship between team planning, SMMs, and coordinated team decision making and performance. Results indicated that effective planning increased the SMM among team members, allowed them to utilize efficient communication strategies during high-workload conditions, and resulted in improved coordinated team performance. In addition, the communication strategy alone affected the degree of coordinated performance attained by teams during periods of increased workload. Implications of these results and team functioning are discussed. Actual or potential applications of this research include performance and training in settings that require interdependent actions among operators.

### **INTRODUCTION**

In dynamic task settings, such as the aviation, nuclear power plant, and medical industries, teamwork is essential for successful job completion. Even minor breakdowns in teamwork can result in unforgiving errors in such complex work environments. Indeed, the accident at Three Mile Island, the USS *Vincennes* incident, and a multitude of aviation mishaps have been attributed to ineffective teamwork (Klein, Orasanu, Calderwood, & Zsombok, 1993; Wiener, Kanki, & Helmreich, 1993). Such well-publicized accidents and incidents have prompted applied psychologists to attempt to determine what contributes to effective teamwork in complex settings.

The concept of shared mental models (SMMs) among team members has been offered as a means to explain coordinated performance in teams, especially in conditions of high workload (Cannon-Bowers, Salas, & Converse, 1993; Rouse, Cannon-Bowers, & Salas, 1992).

In essence, SMMs are thought to provide team members with a common understanding of who is responsible for what task and what the information requirements are. In turn, this allows them to anticipate one another's needs so that they can work in sync. Studies have recently emerged that empirically support the importance of SMMs to team performance (e.g., Blickensderfer, Cannon-Bowers, & Salas, 1997b; Heffner, Mathieu, & Goodwin, 1995; Minionis, 1994; Volpe, Cannon-Bowers, Salas, & Spector, 1996). In addition, the communication literature (e.g., Johnston & Briggs, 1968) suggests interesting implications for the role of SMMs in the use of efficient communication strategies (Stout & Salas, 1993).

In light of this evidence, one might pose the question, "How do we foster the development of SMMs in teams?" The current study is an initial attempt to answer this question. Specifically, we examined the extent to which planning behaviors in a team can foster SMMs. In order to set the stage, we first briefly review

general findings from the literature in three major areas: team communication, SMMs, and planning.

*Team communications.* Although the literature on team communications is plagued by mixed results, one general finding appears consistently when complex tasks are considered: Team effectiveness appears to be enhanced when one or both team members provide information before they are requested to do so (e.g., Entin, Serfaty, & Deckert, 1994; Kanki, Lozito, & Foushee, 1989; Krumm & Farina, 1962; Lanzetta & Roby, 1960; Orasanu, 1990; Oser, Prince, Morgan, & Simpson, 1991; Volpe et al., 1996). Further, providing information in advance appears to be particularly beneficial in situations characterized by increased workload. For example, Orasanu found that when more effective aircrews encountered high-workload conditions, copilots (i.e., non-leaders) increased the amount of information that they provided in advance, whereas pilots or captains (i.e., leaders) decreased the number of requests for information. Less effective crews/teams showed the reverse trend. Considering that Johnston and Briggs (1968) theorized that communications are restricted in high-workload conditions, it appears that in such cases, effective teams contain at least one member who continues to provide information so that others do not need to explicitly request it. SMMs provide an explanation of how effective teams are able to utilize this efficient communication strategy whereas ineffective teams are not.

*SMMs.* As noted previously, a few recent studies have provided evidence of the importance of possessing an SMM in teams. For the sake of brevity, we mention two here. Minionis, Zaccaro, and Perez (1995) reported that when teams were completing subtasks that were interdependent (i.e., that required teamwork), having an SMM resulted in improved performance. However, when subtasks could be completed independently, SMMs among team members did not increase team effectiveness. Blickensderfer et al. (1997b) found that teams that developed greater shared expectations communicated efficiently while completing a radar-tracking task and achieved higher levels of overall performance. These results suggest that forming an SMM of the team, the task, and

the informational requirements of team members serves as an important mechanism for achieving efficient communications and overall improved team performance. A number of methods are available to foster the development of SMMs, one of which is planning (Stout, Cannon-Bowers, & Salas, 1996).

*Planning.* Researchers have reported that planning prior to a mission, during a mission, or both can enhance team performance. For example, the team can set goals, create an open environment, share information related to task requirements (e.g., discuss the consequences of errors and discuss pre-prepared information), and clarify each team member's roles and responsibilities. In addition, teams can discuss relevant environmental characteristics and constraints (e.g., how high workload affects performance, how the team will manage this constraint, and how they will deal with unexpected events), prioritize tasks, determine what types of information all team members have access to and what types of information are held by only certain members, and discuss their expectations, such as how they will back each other up or self-correct. (For more information on team planning, see Blickensderfer, Cannon-Bowers, & Salas, 1997a; Ginnett, 1987; Hackman, 1987; Orasanu, 1990; Stasser, 1992; Zaccaro, Gualtieri, & Minionis, 1995.) Also, the pooling of unshared information can be promoted by, for example, making teams aware that certain information is available only to specific members or by carefully defining each team member's role to reflect the task information that he or she has access to (Stasser, 1992).

The study conducted by Orasanu (1990), which was mentioned earlier, begins to explain how team communications, SMMs, and planning behaviors interact to enhance performance. She found that the more effective teams engaged in more planning types of behaviors than did the less effective teams. More specifically, in more effective teams, the leader used low-workload periods in the mission to make plans. Orasanu explained that these plans helped the team to build an SMM of the situation and to thereby allow commands and information requests to take on meaning. Given that copilots in effective teams also tended to increase the amount of information that they

provided in advance in high-workload periods, we argue that the implication is that planning ahead during low-workload periods allowed the team to develop SMMs such that copilots understood what information to provide without having to be asked. Explicitly, we formulated five specific hypotheses:

- Hypothesis 1:* We expected that members of teams that engaged in better planning during a pre-performance period (theoretically the lowest workload condition possible) would develop greater SMMs of one another's *informational requirements*.
- Hypothesis 2:* We expected that teams that engaged in this better planning would provide more information in advance during periods of high workload (when it is theorized that this type of efficient communication is most needed).
- Hypothesis 3:* We expected that these better planning teams would perform better during these periods of high workload. However, these three hypotheses were formulated by expecting better planning teams to use more efficient communications in high-workload conditions via the SMMs that they developed. This led to our fourth hypothesis.
- Hypothesis 4:* We expected that teams that had greater SMMs would communicate more efficiently during high-workload periods. Similarly, the teams that developed a greater SMM were expected to perform better when workload was high, *as a result of* the more efficient communication strategies that they were enabled to use. This caused us to formulate our final hypothesis.
- Hypothesis 5:* We expected that teams that communicated more efficiently during high-workload periods would perform better during these periods.

Therefore, these better planning teams were expected to perform better in high workload *because* they developed greater SMMs and therefore communicated more efficiently. In other words, Hypotheses 2 and 3 were expected to occur through planning that affected SMMs and communication efficiency, with SMMs and efficient communications being the mechanisms that enabled better planners to communicate and perform better. The purpose of the current effort was to empirically test each of these five hypotheses, providing the first examination of the combined effects of these variables in the literature.

METHOD

Participants

Forty male undergraduate students from a southeastern U.S. university served as participants. Each participant was paid \$50 and received extra credit, when available, for taking part in the experiment. In addition, a \$200 bonus was offered to the best team – that is, the team that gave their best effort on all experimental tasks, attended to all tasks seriously, and outperformed other teams. This judgment was made by the team of experimenters.

Experimental Task

The current task required participants to perform a surveillance/defense mission using Gunship, a commercially available low-fidelity helicopter simulation (Hollis, Tavares, & Meier, 1986). In completing the task, participants

TABLE 1: Information and Tools Available to Each Team Member

Mission Commander (MC)	Second in Command (2ND)
360° instrument for calculating headings	Hard, colored copy of the mission map with landmark letters and number coordinates
Computer gauge that indicates the name of the target	Computer gauge that shows small picture of the map mode
Target chart to look up target numbers (e.g., 10, 24)	Mandatory log
	Keyboard for entering/exiting the map mode, engaging targets, selecting weapons, and firing on a target
	Target to look up target letters (e.g., D, C)

worked as part of a larger team consisting of two experimenters (i.e., the mission control specialist and the contractor pilot) and two participants. Participants were randomly assigned to one of two team positions, either the mission commander (MC) or the second in command (2ND). In completing the mission, each team member had a specific set of tasks to accomplish. As illustrated in Table 1, these tasks were based on the tools each team member was given, the specific information to which each teammate had access, and various rules associated with the overall mission. That is, neither the MC nor the 2ND had all the necessary tools and information to perform the mission alone. Thus the two had to pool their resources to complete all mission-related tasking.

Further, the scenario was divided into four flight segments in which teams needed to act interdependently to complete surveillance and defense-related tasks. For example, the surveillance (i.e., navigational) tasks included calculating flight headings that allowed the team to fly to various landmarks as they received updates. This portion of the mission was structured such that the MC had the tool for physically calculating the headings, but the 2ND had access to information that would enable the heading to be calculated (e.g., its coordinates, what it looked like) and to make their turn call when the landmark was reached. Defense-related tasks required the team to engage and destroy enemy targets that appeared on their surveillance course. To do so, the team had to pool their information in order to decide whether or not a target should be fired upon. Finally, the scenario was designed to include varying levels of workload. Thus, during Segments 1 and 2, the team performed surveillance or navigational tasks only (low workload). However, during Segments 3 and 4, the team simultaneously performed surveillance and defense tasks (high workload). The experimental task took approximately 35 min to complete.

### Independent Measure

The overall planning quality of each team was based on nine planning dimensions that were identified as important in the literature (e.g., Ginnett, 1987; Hackman, Brousseau, &

Weiss, 1976; Hackman & Walton, 1986; Moore, 1978). In addition, the planning behaviors identified were expected to enhance performance on the specific task employed. The planning dimensions were (a) creating an open environment, (b) setting goals and awareness of consequences of errors, (c) exchanging preferences and expectations, (d) clarifying roles and information to be traded, (e) clarifying sequencing and timing, (f) unexpected events, (g) how high workload affects performance, (h) pre-prepared information, and (i) self-correcting. To derive a measure of planning quality, we followed an approach that has been widely accepted in the assessment center literature (Thorton & Byham, 1982). That is, using a 7-point Likert-type scale (1 = low end of the scale, 7 = high end of the scale), each of two raters first made an individual assessment of how well the team planned in relation to each of the specific planning dimensions and then provided a rating for the team's overall planning. The two raters then met to discuss their individual ratings and formed a consensus rating for each of the specific planning dimensions and for the overall planning quality of the team. Raters were unaware of experimental conditions.

Regarding the rating for the team's overall planning quality, six teams were rated as 1, 2, or 3 (what we considered to be low in planning quality), seven teams scored a 4 or 5 (what we considered to be average in planning quality), and seven teams were rated 6 or 7 (what we considered to be high in planning quality). Because we were interested in testing differences between teams that planned well and those that planned poorly, we dropped the average planners from our analyses. The means for our low and high planning quality groups were 1.67 and 6.29, respectively.

### Dependent Measures

Three dependent measures were collected: (a) an SMM measure based on Pathfinder C (Schvaneveldt, 1990), (b) the rate of communications provided in advance during each scenario segment, and (c) the number of errors made during each scenario segment. It should be noted that to test Hypotheses 4 and 5, the SMM measure and the provisions of information in advance measure, respectively, served

as independent variables in the analyses. It should also be noted that communication ratings and a portion of the error calculations were completed after experimental sessions using a videotaped recording of each team. In addition, a separate set of raters was used to collect the communication and performance (i.e., errors) measures. All raters were blind to experimental conditions, and none had been assigned to assess planning quality. Each of the dependent variables will be briefly discussed.

**SMM measure.** Participants were presented a pair of concepts related to their mission and were asked to rate how informationally related the concepts were using a 7-point Likert-type scale (1 = very unrelated, 7 = very related). For example, two informationally related concepts were "2ND tells MC what target looks like and how many miles away it is" and "MC tells 2ND which weapon to use." These items were informationally related given that the MC needed a physical description of the target and the target's distance before he could determine which weapon to use and before he could inform the 2ND of this. Participants completed a total of 190 paired comparison judgments.

The structural assessment technique Pathfinder *C* (Schvaneveldt, 1990) was used to generate each team member's mental model based on the paired comparison judgments provided. Stout et al. (1996) argued that measures of knowledge structures, such as Pathfinder, can be used as a representation of an individual's mental model. Essentially, Pathfinder takes raw comparison ratings and transforms them into a network structure. Concepts that are highly related to one another are more closely linked within the structure (Kraiger, Salas, & Cannon-Bowers, 1993). Using Pathfinder, we computed an index referred to as *C* (closeness) to test the degree of similarity between the two team members' configural networks or mental models. Therefore, we considered *C*, as suggested by Stout et al. (1996), to be an index of the team's SMM. The values of *C* range from 0 to 1, with 1 representing perfect similarity. It should be noted that little has been reported on the psychometric properties of knowledge structure measures such as Pathfinder. However, Gualtieri, Fowlkes, and Ricci (1996) recently provided some evidence of the reliability

of *C*. Further, Schvaneveldt et al. (1985) found that a group of expert pilots had more similar Pathfinder scores (i.e., *C* was higher) than did a group of novice pilots. According to Goldsmith and Kraiger (1997), this is indicative of the structural assessment technique's validity.

**Provisions of information in advance.** The scenario was specifically designed to require continuous provisions of information in advance (assumed to equate to more efficient communications). For example, at one point in the mission, the team approached two land patches that were exactly the same (i.e., they were the same in size, shape, and color). However, the MC did not have the resources to determine which landmark was the correct one. It was expected that effective 2NDs would provide their teammate with the necessary information to discriminate between the two landmarks, thus allowing the team to turn to their next heading when they reached their intended landmark. For example, when approaching a landmark, the 2ND might say, "It's not the first green land patch, it's the second one." Although the MC could have asked his teammate for clarification when it was needed, certain tasks had to be completed within a limited time frame, and at times tasks were being performed simultaneously. By providing information in advance, the team could avoid unnecessary communications and remain focused on accomplishing their tasks.

Two trained raters used a standard checklist that identified 18 specific pieces of information that should be provided in advance. The identification of these information provisions was based on each team member's specific task and the information each required to complete his individual role. Because the time it took to perform each segment of the scenario varied among teams, segments were timed for each team and communication rates per segment were derived. These communication rate indices were used in all data analyses. Based on an average of all possible pairings of ratings obtained across raters, a correlation was computed ( $r = .96$ ) that suggested high agreement between the raters.

**Mission errors.** Performance was assessed via errors made by the team. The errors calculated for each team were based on information

that participants received related to the rules of the task (e.g., standard operating procedures). Examples included being in the "map mode" for more than the allotted time, making a calculation to an incorrect landmark, missing a turn call, and using an incorrect sequence to determine the intent of targets. A standard error sheet was developed for trained raters to use while making their assessments via videotape of each team's performance. Consistent with the procedure described in the previous section, we obtained an average of all possible pairings of ratings across raters and types of errors, from which a correlation was computed ( $r = .87$ ); thus there was a high degree of agreement among the raters. In addition, a trained observer used a standard error sheet to record errors made by the team members on site that could not be captured via the videotape (e.g., placing the calculation instrument on the wrong landmark, holding the calculation instrument upside down, incorrectly filling out logs). The total number of errors made by each team was therefore calculated by adding the errors captured through on-site observation and through videotape assessment.

### Procedure

Upon arriving at the experimental session, participants completed an informed consent form and were randomly assigned to one of two team positions (i.e., MC or 2ND). Participants then had an instruction and practice period that lasted approximately 1.5 h. During this time, participants practiced all experimental tasks that were associated with the MC's and 2ND's position, but they were not informed until later which set of tasks each team member would perform during the mission. Thus, at the end of the practice period, it was expected that participants would be proficient at all individual tasks, given that they had essentially been cross-trained. Following the instruction and practice period, all teams were given an opportunity to plan for their mission. When the planning period began, the team was informed that both team members had a broken gauge, but that they were different gauges. The respective gauge for each team member was then occluded on his computer screen. Each team member received a set of weapon

hints, and they were told that they differed from those that their teammate had been given. Also, the 2ND received a hard copy of the mission map. Finally, the team was given a series of landmarks that they would be flying to at some point during the mission. Once the team received all of their instructions, they were allotted 45 min to plan for their mission.

Therefore, as suggested by Stasser (1992), the planning period was designed to promote the pooling of information that was unique to each specific team position (e.g., by giving the team new information, by informing the team that each team member was given different information). For example, because the gauges had not been broken during the practice session, it was important that each team member share what information he no longer had access to on his screen and would need to be provided with during the mission. Similarly, teams had not seen the weapon hints during the practice session, and because the team members had been given different sets of weapon hints, it was in their best interest to review this information and determine how it could best be utilized. Additionally, by giving the team the series of landmarks and the hard copy of the mission map, the team could plot out this portion of the course during the planning session and develop strategies for completing this portion of the mission. It should be noted that the team had not practiced surveillance and defense tasks simultaneously. Therefore, it was expected that the team would need to discuss how they would handle this situation when it was encountered. In short, the team was expected to make plans about several issues that were expected to be important to task performance.

Following the planning session, participants completed the SMM questionnaire, which presented the paired comparison items discussed earlier. The team then performed their mission. On completion, all participants subjectively assessed the workload of each scenario segment using a 7-point Likert-type scale in which 1 indicated very low workload and 7 indicated very high workload. The means obtained (i.e., Segment 1 = 3.33, Segment 2 = 2.88, Segment 3 = 4.50, Segment 4 = 5.78) were in the predicted direction. Thus, based

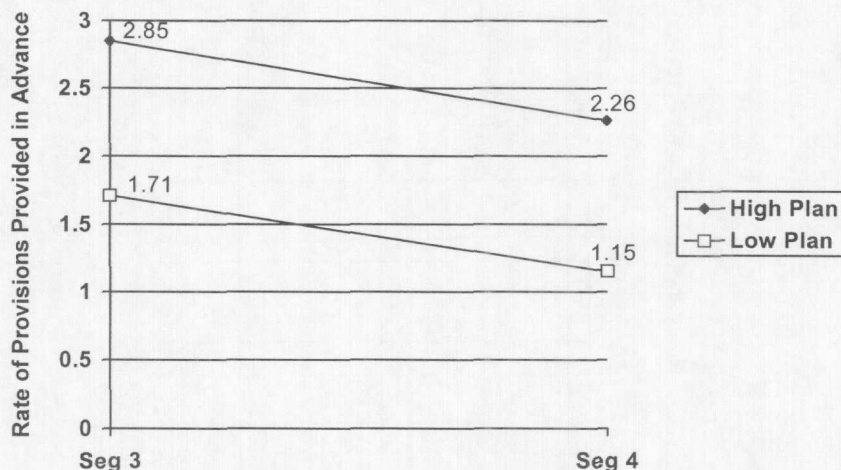


Figure 1. Rate of provisions of information provided in advance for teams high vs. low in overall planning quality.

on this measure, participants appeared to correctly perceive the increase in workload associated with the segments that were designed to impose higher workload.

The scenario was designed by the lead author, who has had extensive experience in designing scenarios for other team tasks and created the current experimental task. It was her intention and judgment that Segments 3 and 4 did indeed impose higher workload. Furthermore, after performing the task, several researchers who also have vast extensive knowledge of scenario development but who were not directly involved with this effort concluded that the last half of the mission (i.e., Segments 3 and 4) was definitely characterized by higher workload.

## RESULTS

**Hypothesis 1.** The mean Pathfinder *C* obtained was .55 and .22, respectively, for teams rated high (i.e., 6, 7) and teams rated low (i.e., 1, 2, 3) in overall planning quality. Results revealed that this hypothesis was supported,  $F(1, 11) = 5.50, p < .05$ . Therefore, team members in teams that planned better developed a greater SMM of each other's informational requirements than team members in teams that were categorized as lower in planning quality, as hypothesized. It should be noted that whereas the means for *C* may

appear to be somewhat low, they are consistent with scores reported in previous studies. Further, Goldsmith and Johnson (1990) argued that this index should not strictly be considered the same as a correlation, in which case a higher value would be expected.

For Hypotheses 2 through 5, we were interested in investigating only whether groups differed during the high-workload segments (i.e., Segments 3 and 4), because the literature in this regard suggests that important differences are likely to be found under high-workload conditions but not necessarily under low-workload conditions. Thus, planned comparisons were performed in testing the remainder of the experimental hypotheses.

**Hypothesis 2.** To test this hypothesis, the rate of information provisions utilized by teams high and low in planning was considered. In testing this hypothesis, the results of our analysis revealed that teams high and low in planning did differ significantly in the rate of communications provided in advance during Segment 3,  $t(11) = 2.58, p < .05$ , and during Segment 4,  $t(11) = 2.66, p < .05$ . An examination of the means (Figure 1) confirmed that this difference was in the predicted direction. Thus, as hypothesized, teams that demonstrated overall higher quality planning behaviors used the more efficient communication strategy when it was most critical to do so (i.e., when their workload increased).



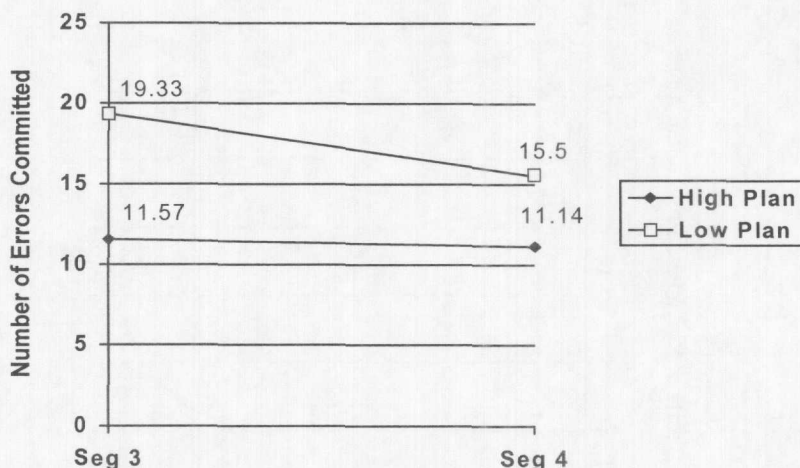


Figure 2. Number of errors committed by teams high vs. low in overall planning quality.

**Hypothesis 3.** In investigating this hypothesis, we tested whether teams that were categorized as high in planning committed fewer errors in Segments 3 and 4, which were associated with increased workload. The results indicated that teams high and low in overall planning quality did differ significantly in their performance during Segment 3,  $t(11) = -3.90$ ,  $p < .01$ , and Segment 4,  $t(11) = -1.92$ ,  $p < .05$ . An examination of the means (Figure 2) confirmed that this difference was in the predicted direction for both high workload segments. Thus, teams that engaged in higher quality planning performed significantly better during higher workload periods, as hypothesized.

**Hypothesis 4.** To test whether teams with a greater SMM provided more information in advance during high-workload segments, the rate of information provided in advance for Segments 3 and 4 was considered. Results indicated that teams with a greater SMM of each other's informational requirements did not demonstrate higher rates of information provisions during high-workload conditions. Thus, this hypothesis was not supported.

**Hypothesis 5.** To test this hypothesis, we investigated whether teams that demonstrated a higher rate of information provisions in advance made fewer errors during high-workload segments than did teams that demonstrated a lower rate of information provisions. Based on a quartile split, teams categorized as using more- and

less-efficient communication strategies did differ significantly in their performance during Segment 3,  $t(9) = -3.53$ ,  $p < .01$ , and Segment 4,  $t(8) = -2.07$ ,  $p < .05$ . An examination of the means (Figure 3) confirmed that this difference was in the predicted direction for both of the higher workload segments. Therefore, teams that provided a higher rate of information in advance were found to perform better in both of the high-workload segments, as hypothesized.

## DISCUSSION

The results of this study indicate that members of teams that engaged in high-quality planning were able to form a greater SMM of each team member's informational requirements, to pass information to each other in advance of explicit requests for this information during high-workload periods, and to make fewer errors during these periods. Additionally, providing information in advance appears to result in better performance when time is of the essence. We will now discuss the implications of these results as they pertain to each of the stated hypotheses in turn.

In examining the hypotheses related to planning quality, results first supported the crucial hypothesis that teams that planned better had a greater SMM of the informational requirements of each team member. Thus, for the first time, evidence has been produced

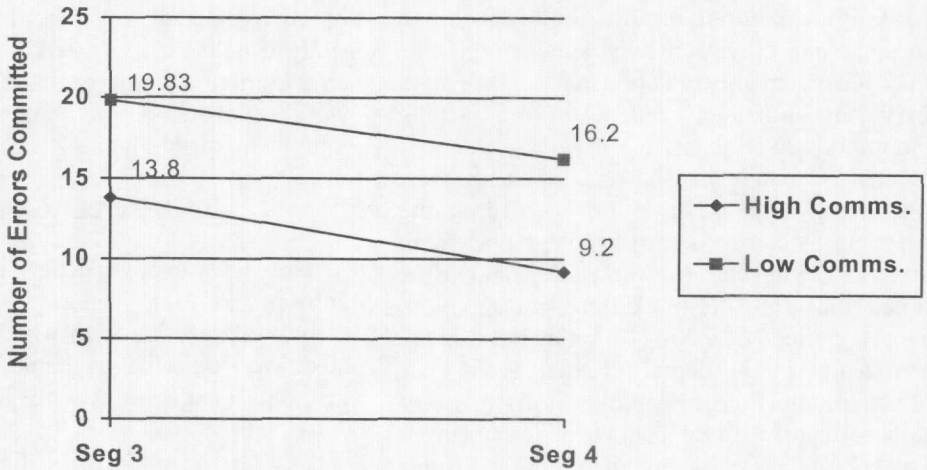


Figure 3. Number of errors committed by teams who provided a high vs. low rate of communications in advance.

that certain team behaviors – namely prebriefing or planning behaviors – can influence the degree to which team members share an understanding of each other's needs and informational requirements.

Second, results suggested that the teams high in planning used more efficient communication strategies when they were expected to – during the higher workload periods. These findings are important because they provide new insight into how teams function. That is, considering that the literature suggests that an SMM allows team members to interact effectively (Cannon-Bowers et al., 1993), high-quality planning increased the SMM of team members such that they were presumably able to form shared expectations and explanations of each other's informational requirements. High-quality planning also helped teams to use these expectations and explanations to anticipate each other's informational needs and to provide information that was required in advance of explicit requests for that information *when it was most important to do so* (i.e., when time was of the essence during higher-workload periods).

Third, teams that planned better were found to perform better during both segments associated with increased levels of workload. It is interesting to note that during Segment 3, teams had to start to deal with both navigational and defense tasks simultaneously for the

first time in the mission, and this dual-tasking continued throughout the entire fourth segment. This suggests that teams that had planned better were able to effectively manage the increase in workload they encountered and avoided making errors. This is important because significant changes in task demands can cause disastrous consequences if teams are not able to adequately deal with them. Thus, this provides some empirical support that effective planning may be a means of enabling coordinated performance under increased workload conditions.

Fourth, teams with a greater SMM were not found to use more efficient communication strategies than teams with a lower SMM during the high-workload periods, as hypothesized. This is perplexing, given that the literature suggests that planning may have an effect on communication strategies and performance through shared mental models. Several potential explanations of this paradoxical result exist, however. First, this suggests that there was something about better planning that directly influenced communication and performance, independent of whether team members held a common understanding of each other's informational requirements. Alternatively, it is possible that the SMM measurement itself provided cues for performing the task, allowing for more efficient communication strategies in the absence of SMMs of

team informational requirements developed during planning. Specifically, some participants may have remembered information presented in the questionnaire (e.g., when approaching landmark, 2ND tells MC, "It's not the first green land patch, it's the second") and, thus, may have made assumptions regarding the information that should be provided in advance during the mission. Still, it should be noted that short-term planning during more routine periods of the mission may have equalized teams in the degree of their SMM. The effects of short-term planning during mission/task performance require further investigation. Further, the development of on-line measures of cognitive states is needed to determine whether teams that use more efficient communication strategies and perform better do so because they have a better understanding of each other's informational requirements in situ that cannot be tapped by a static measurement prior to task performance.

Finally, results indicated that teams that used more efficient communication strategies were found to perform significantly better (i.e., made fewer errors) in segments characterized by high workload than teams that used less efficient communication strategies. Thus, this finding provides further support to what has been reported in the literature (e.g., Entin et al., 1994; Krumm & Farina, 1962; Volpe et al., 1996). Through engaging in efficient communications, teams in the current study were able to effectively adapt to increased levels of workload while maintaining a high degree of coordinated performance.

## CONCLUSIONS

We feel that the findings reported here provide a new understanding of how teams function that has not been empirically documented elsewhere. We argue that our results are applicable to any team where conditions are complex and dynamic and coordinated decision making is required. The use of a laboratory research design and undergraduate participants helped to increase the generalizability of our results across teams and settings. Indeed, Driskell and Salas (1992) argued precisely this point. Of course, to increase the specific generalizability

of our results to any particular settings, the study should be replicated in the operational environment of interest. We hope that our work stimulates further interest and research into the important issues advanced here.

## ACKNOWLEDGMENTS

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