Accelerating Unit Adaptability: A Principle-based Approach to Unit Communication

Tara Rench, Zachary Horn, Alexander Walker
Aptima, Inc.
Woburn, MA
Trench@aptima.com, Zhorn@aptima.com, Awalker@aptima.com

Steve Zaccaro
George Mason University
Fairfax, VA
szaccaro@aol.com

ABSTRACT

Mission success in today's decentralized military relies increasingly upon highly adaptive decision-making by small units. Successful adaptation requires units to communicate in ways that facilitate coordination and shared understanding within and outside of the unit (Marks, Zaccaro, & Mathieu, 2000). However, communication breakdowns are prevalent within small units, especially when operating in highly stressful environments. While unit leaders and members are formally trained in communication basics (e.g., how to operate communication devices, preparing and delivering orders, etc.), it is possible that additional training on the deeper principles of team communication can promote improved unit awareness, decision-making, and adaptation. In response, a framework was developed to support training, monitoring, and assessment of Coordinated Tactical Communications in Teams (CONTACT), particularly in the face of situational stressors that create a need for unit adaptation. Leveraging existing Navy-funded team communication research (e.g., Bowers, Jentsch, Salas, & Braun, 1998; Entin & Serfaty, 1999; Smith-Jentsch, Zeisig, Acton, & McPherson, 1998; Waller, 1999) and operational expertise from active duty Marines, six distinct communication principles were identified: Relevance; Quality; Timeliness; Frequency; Information Flow; and Confirmation and Response. These principles provide a common language that help leaders and units align pre-mission communication expectations, assess and adjust within-mission communication, and conduct post-mission reviews of communication strategy. Additionally, six situational stressors are described that significantly affect the application of these communication principles: Uncertainty, Risk, Time Demand, Mental/Physical Demand, Lack of Unit Familiarity, and Broken Communications. Present to varying degrees in most situations, units must recognize these stressors and adapt communications appropriately. Feedback from Marine Corps instructors highlights the promise and utility of the CONTACT framework to help leaders set communication expectations, assess communication during missions, and hold more efficient after-action reviews (AARs). The CONTACT framework and its intended training and assessment applications will be discussed in depth in the current paper.

ABOUT THE AUTHORS

Tara Rench, M.A., is an Industrial-Organizational Scientist at Aptima, where she is engaged in the design of training interventions that are based on the principles of sound instructional design and scientific theory with the goal of maximizing learning, decision-making and performance.

Zachary Horn, Ph.D., is a Senior Scientist at Aptima, where he conducts applied research and development for a variety of advanced training and assessment applications. His research focuses in areas such as leadership strategy development, adaptive decision making, team dynamics, and organizational climate.

Steve Zaccaro, Ph.D., is a Professor of Industrial and Organizational Psychology at George Mason University, and an experienced consultant in leadership development and team effectiveness. His research focuses on training principles for growing adaptability skills, fostering leader and leadership growth, and on developing effective multiteam systems.

Alexander Walker, Ph.D., is a Senior Scientist at Aptima, where he is engaged in the design of training interventions and assessments to improve the cognitive and perceptual skills associated with effective decision making of individuals and teams.

Accelerating Unit Adaptability: A Principle-based Approach to Unit Communication

Tara Rench, Zachary Horn, Alexander Walker
Aptima, Inc.
Woburn, MA
Trench@aptima.com, Zhorn@aptima.com, Awalker@aptima.com

Steve Zaccaro
George Mason University
Fairfax, VA
szaccaro@aol.com

INTRODUCTION

Mission success in today's decentralized military relies increasingly upon highly adaptive decision-making by small units. Successful adaptation in an operational environment requires that small units are able to coordinate and communicate effectively under unpredictable and quickly fluctuating conditions. When teams communicate well, they are more likely to maintain up-to-date levels of shared awareness, coordinate more effectively, and engage in more adaptive and efficient decision-making (Burke, Stagl, Salas, Pierce, & Kendall, 2006; Marks, Zaccaro, & Mathieu, 2000). However, in recent discussions with Marine Corps instructors, communication breakdowns were among the most common problems teams faced during training exercises. Additionally, research on action teams – including, emergency medical teams, military teams, and air crews – provides evidence that communication breakdowns are prevalent, especially when operating in highly stressful environments (Kohn, Corrigan, & Donaldson, 1999; Wilson, Salas, Priest, & Andrews, 2007). As a result, the team's situation awareness and decision making quality also deteriorate and the safety of the team and the success of the mission are jeopardized (Wilson et al., 2007).

To ensure that units communicate and perform effectively under these conditions, the United States Marine Corps (USMC) is actively developing small unit leader training focused on improving higher-order cognitive skills, such as problem solving, critical thinking, and decision making (USMC, 2011). In line with this initiative, small unit leaders need to be trained to think more deeply about communication to be able to effectively adjust what, when, how, and to whom information is communicated under different conditions. Currently, formal training practices in the Marine Corps focus on training basic communication skills, including how to write and communicate orders and how to operate the radio. While these skills are critical to effective communication, it is proposed that there is also a need to train generalizable principles of communication that support unit awareness, decision making and adaptation. Additionally, to help leaders learn how to apply these principles across situations, there is also a need to improve leaders' understanding of what situational factors may impact unit communication. Rather than providing a comprehensive list of what to communicate in every possible situation (which is not feasible), the goal is to provide generalizable principles and guidelines that can help leaders begin to see and make the connections between situational factors, communication, and outcomes.

The current paper describes the development of a framework that can improve leaders' understanding of critical communication principles (e.g., what should I look for when assessing the effectiveness of my unit's communication?) and the situational factors that may impact communication (e.g., what aspects of the current or upcoming situation may cause communication problems within my unit?). Based on evidence from the literature and input from Marine Corps subject matter experts (SMEs), the primary utility for the framework is for leaders to more effectively and efficiently set communication expectations, assess unit communication performance, diagnose strengths and weaknesses, and provide targeted, actionable feedback about how to improve communication in the future.

FRAMEWORK DEVELOPMENT

To develop a framework that was theoretically sound and operationally relevant, the research team employed an iterative design and development process that consisted of extensive reviews of the literature, multiple workshops with Marine Corps and Army SMEs, and discussions with and feedback from a team theory expert. Specifically,

existing team theories, such as macrocognition (e.g., Fiore et al., 2010), team sensemaking (e.g., Klein, Wiggins, & Dominguez, 2010), and team adaptation (e.g., Burke et al., 2006), were reviewed to better define the communication domain and to help shape the foundation of the framework. From these theoretical perspectives, communication is defined as a means for information and knowledge sharing, which facilitates team knowledge building, situation awareness, and ultimately, decision making. For example, the macrocognition literature emphasizes that communication is a necessary component for transforming internalized knowledge (belonging to a single individual) into externalized knowledge (shared across team members; Fiore, et al., 2010); thus, breakdowns in team communications can lead to knowledge gaps which can have dangerous implications for a unit. From the team sensemaking perspective (Klein, et al., 2010), researchers propose that communication is critical for setting expectations, clarifying goals, and providing team members with an appropriate frame (or mental model) for understanding the situation. As a result, team members are better able to recognize *what* information is meaningful and *to whom* communications should be delivered (that is, the proper *information flow* throughout the team). Together, these theories highlight some of the critical elements of communication that need to be addressed in the framework. The research team also leveraged a large body of research focused on team communications and decision making to further understand the communication domain. In particular, the body of work coming out of the Tactical Decision Making Under Stress (TADMUS) initiative (e.g., Entin & Serfaty, 1999; Smith-Jentsch, Zeisig, Acton, & McPherson, 1998), sponsored by the Office of Naval Research (ONR), contributed greatly to the development of the framework content. Additionally, workshops with Marine Corps and Army SMEs shed light on the aspects of communication that are critical to success in the operational environment, as well as the challenges units face that may make communication more difficult. Finally, discussions with a team theory expert helped the research team identify and draw conclusions from relevant literature, define and revise the set of communication principles and stressors, and make connections between the stressors and communication principles. The final framework, as seen in Figure 1, consists of a comprehensive, yet parsimonious, set of communication principles and situational stressors that resulted from this effort. The sections below provide more detailed information regarding the development of the framework.

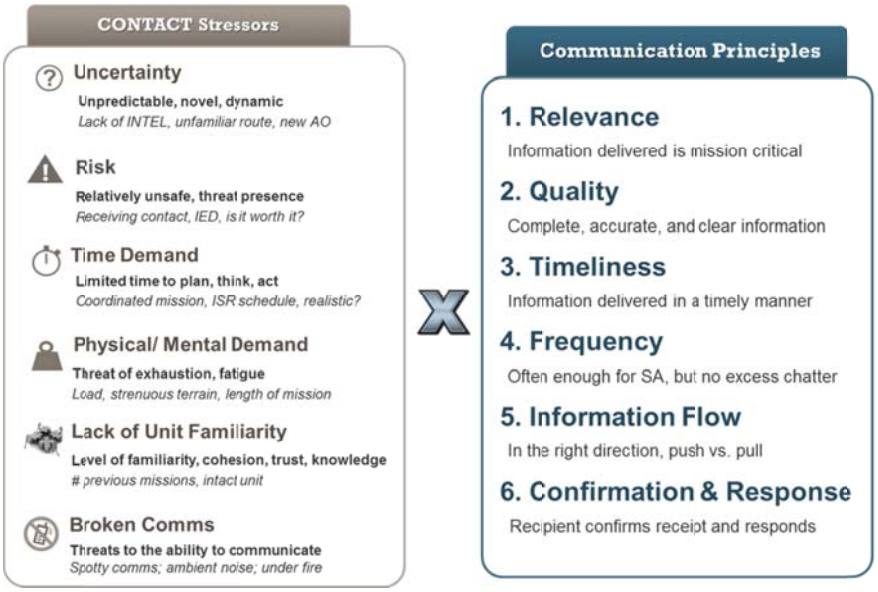

Figure 1. Final Team Communication Framework

Communication Principles

The communication principles listed in Figure 1 were largely driven by existing research, as described above. Specifically, the communication behaviors and performance measures identified in the TADMUS work (e.g., Entin & Serfaty, 1999; Smith-Jentsch, et al., 1998) contributed greatly to shaping the set of communication principles. For example, Team Dimensional Training (TDT; Smith-Jentsch et al., 1998) is a structured method of prebriefing and debriefing teams that guides teams through a process of self-correction. It is designed to augment the feedback component of Crew Resource Management (CRM), though it is more structured than CRM and adds instructional

elements to the debrief, with the goal of monitoring and regulating behaviors. TDT categorizes components of effective teamwork into 4 dimensions: information exchange, communication, supporting behaviors, and leadership/followership. The primary dimensions investigated for the current research were information exchange (what information to pass on to whom and when), and communication (how information is passed). These dimensions highlight several aspects of communication that are likely to be important for the proposed framework, including: relevance (do team members know what information to share?), quality (do team members accurately describe information in a clear and concise manner?), nature of information exchange (or flow) within a team (e.g., do team members proactively seek and request information?), frequency (do team members know how often to share information?), and timeliness (is information passed when it is needed?). Work by Wilson, et al. (2007) also highlighted information exchange and quality (phraseology) as important aspects of communication, as well as identifying closed-loop communication as another important element of communication. Closed-loop communication may include the: (1) acknowledgement of requests, (2) acknowledgement of receipt of information, and (3) verification that information sent was interpreted as intended. Together, this work provided a solid foundation upon which to identify the relevant principles of communication. Specifically, the initial set of principles represent three broad aspects of communication performance: *what to communicate* (relevance, quality); *when to communicate* (timeliness, frequency), and *how to communicate* (information flow, closed-loop communication). Table 1 lists the initial set of principles and provides a brief description of each, along with a couple of examples of communication behaviors from the literature that correspond with that principle.

Table 1. Initial Set of Communication Principles from the Literature

Principle	Description	Example Good/ *Bad* Communications
Relevance	Is the information being communicated the most important, relevant, and high priority given the current context?	• Pass important or high priority information first (Entin & Serfaty, 1999) • *Report low priority information before higher priority information (Entin & Serfaty, 1999)*
Quality	Is information being communicated complete, accurate, clear, and brief given the current situation?	• Speak in clear, intelligible tone of voice (Smith-Jentsch, et al., 1998) • *Pass on incomplete communications (Entin & Serfaty, 1999)*
Timeliness	Is information communicated in a timely manner – that is, before a decision needs to be made?	• Provide information in a timely manner (Waller, 1999) • *Fail to pass along information before a decision needs to be made (Entin & Serfaty, 1999; Waller, 1999)*
Frequency	Are communication updates being provided at an appropriate interval?	• Avoid excess chatter (Smith-Jentsch, et al., 1998) • *Routine updates infrequent or absent (Smith-Jentsch et al., 1999)*
Information Flow	Is information flowing in the right direction within the unit and pushed/pulled as needed?	• Pass relevant pieces of information before being asked (Smith-Jentsch, et al., 1998; Entin & Serfaty, 1999) • *Waiting to be asked for information under high stress conditions (Entin & Serfaty, 1999)*
Closed Loop	Did the recipient confirm the information communicated and provide an appropriate response as needed?	• Ensure that messages are received as intended (Entin & Serfaty, 1999) • *Fail to acknowledge other member's requests or reports (Entin & Serfaty, 1999)*

Once the initial set of principles was developed, the research team used a scenario-based knowledge elicitation method to gather feedback from three Marine Corps Infantry Unit Leader Course (IULC) instructors on: (1) the relevance of the principles, and (2) additional principles not present in the initial list. Instructors had the opportunity to walk through a real-life scenario, authored by two internal Marine Corps SMEs, and consider how the principles can be used to talk about communication challenges units may face during a mission, under different situational conditions.

While communication is taught and frequently discussed within the Marine Corps, the instructors acknowledged that a high-level list of team communication principles was missing from current training practices. The instructors

supported the initial list of communication principles, suggesting that it was comprehensive and operationally relevant. All of the important aspects of team communication independently identified by the instructors before they reviewed the list also fit nicely into one of the six principles. As a result, the initial list of six principles was retained for the final framework. The only edit made to the list of principles was a change in title for the *Closed Loop* principle to *Confirmation and Response*. The instructors felt that the revised title was more intuitive, less ambiguous, and more closely aligned with communication than the original title.

The instructors also provided several operational examples for each of the principles, which were later supplemented by two additional SMEs: a Retired USMC Master Sergeant, and a Retired Army Master Sergeant. These examples were used to develop descriptions of what good communication should look like for each principle (see Table 2).

Table 2. Communication Principles with Examples

Principle	Description	What does "Good" look like?	Examples
Relevance	*Is the information being communicated the most important, relevant, and high priority given the current context?*	*Communicates information that is:* • Highest priority first • Important • Mission critical (i.e., driven by mission order, commander's intent) • Appropriate for the current situation – could be at the tactical, operational, or strategic level • Appropriate for the target (i.e., what is relevant to send to Company Commander is not necessarily what is relevant to send to Squad Leader)	***Good:*** *The point reporting to the patrol leader that civilians on the roof of a two story house up ahead along the route appear to be carefully observing the progress of the patrol.* ***Bad:*** *The point failing to report to the patrol leader that civilians on the roof of a two story house up ahead along the route appear to be carefully observing the progress of the patrol because they are unarmed.*
Quality	*Is information being communicated complete, accurate, clear, and brief given the current situation?*	*Communicates information that is:* • Complete • Accurate • Clear and Understandable • Concise • Does not require follow-up questions or dialogue	***Good:*** *"This is First Platoon, contact at grid 123456. Full Contact Report to follow."* ***Bad:*** *"Contact, 100 meters to my front" when you are unsure exactly how far the contact is and whether your supporting units know which direction you are facing.*
Timeliness	*Is information communicated in a timely manner – that is, before a decision needs to be made?*	*Communicates information that is:* • Early enough for it to influence a decision or action • Not so early that it leads to inappropriate action	***Good:*** *Requesting a helo as soon as you think you need one, which makes it more likely that it will arrive when you need it.* ***Bad:*** *Not requesting a helo as soon as you think you need one, but requesting it after establishing an LZ, making it less likely that it will arrive when you need it.*

Principle	Description	What does "Good" look like?	Examples
Frequency	*Are communication updates being provided at an appropriate interval?*	*Communicates information that is:* • Often enough to support continued SA on three types of updates: routine updates, mission critical updates, and immediate or emerging situation updates • Often enough to each level (higher, subordinates, laterally) • Often enough to confirm that comms are working • At an optimal balance between too much and too little	***Good:*** *Updates allow small unit leader to keep SA outside of his line of sight, but is not flooded with excess chatter.* ***Bad:*** *Routine updates are too infrequent, not allowing the small unit leader to assess the status of the mission.*
Information Flow	*Is information flowing in the right direction within the unit and pushed/pulled as needed?*	*The flow of information is:* • Optimal for a given situation • Pushed under high stress situation (either from higher or lower) • Pulled when information is necessary that has not been received • Occurring in all directions as appropriate (up, down, laterally)	***Good:*** *Squad Leader anticipates what information is needed by the Platoon Commander and proactively pushes that information to the leader at the right time.* ***Bad:*** *Squad Leader only shares information after it is requested multiple times by the Platoon Commander.*
Confirmation and Response (formerly Closed Loop)	*Did the recipient confirm the information communicated and provide an appropriate response as needed?*	*When information is communicated:* • The sender requests confirmation and acknowledgement of receipt • The receiver acknowledges transmission • Individuals signal when all information available has been passed	***Good:*** *A request for an updated ammo count is acknowledged ("Roger, get an ammo count") and a response is communicated ("200 rounds of 5.56, six grenades, two white star clusters").* ***Bad:*** *A request for an updated ammo count is not acknowledged, so the leader is forced to ask multiple times because he does not know if he will get one otherwise.*

Situational Stressors

While Table 2 provides some general guidelines and examples to help define effectiveness for each principle, it is also important to consider the situational context in which the communication occurs. Various stressors may be present within the operational environment at any one time, and it is likely that these stressors will have varying effects on communication (Liang, Ndofor, Priem, & Picken, 2010; Marks, Zaccaro, & Mathieu, 2000; Wilson et al., 2007). The goal was to identify a list of common stressors that may impact how a team will and/or should communicate. Entin and Serfaty (1999) discussed three sources of stress – uncertainty, ambiguity, and time pressure, and found that teams who perform well under stress operate differently than teams who fail under stress. Specifically, the communication patterns of successful teams under stress are different than those of less successful teams, suggesting that leaders need to be able to recognize when the team is operating under different types of stressful conditions and encourage team communication strategies or procedures that are most effective under those conditions. Cannon-Bowers and Salas (1998) listed several additional stressors, including adverse physical conditions, threat, and workload, all of which may drain resources necessary to think, act, and communicate effectively. The initial set of situational stressors listed in Table 3, along with brief descriptions and examples, were driven by this previous research.

Table 3. Initial Set of Situational Stressors from the Literature

Stressors	Description	Example Situation
Uncertainty	Is the current situation: - Clear cut, predictable, routine, and stable (low uncertainty), or - Uncertain, unpredictable, novel, and dynamic (high uncertainty)	• High uncertainty: e.g., lack of INTEL, outdated INTEL, or contradictory INTEL; unfamiliar AO or route; new mission type
Risk	Is the current situation: - Relatively safe, low-risk, no immediate threat, or - Relatively unsafe, high-risk, immediate threat	• High risk: Receiving contact
Time Demand	Is the current situation characterized by: - Low time demand (no rush, time to plan, think, act), or - High time demand (rush, no/limited time to plan, think, act)	• High time demand: Due to availability of ISR assets, coordinated mission schedule, etc.
Physical Demand	Is the current situation imposing: - Low physical demand - High physical demand	• High Demand: Heavy load (extra batteries; gear), strenuous physical activity due to terrain

During the workshop with Marine Corps instructors, the research team described each of the stressors and asked instructors to provide feedback on: (1) the operational relevance of the stressors, (2) additional stressors not present on the initial list, and (3) ways in which the stressors may impact communication. Additionally, the instructors identified stressors at play in the real-life scenario created by internal Marine Corps SMEs, and helped identify additional examples for each of the stressors.

Overall, the instructors' reactions to the stressor list were positive – all instructors indicated that these four stressors were relevant to operations and had the potential to impact unit communications and effectiveness. Instructors noted, however, that as physical fatigue and demands increase, one's mental capacity can also become diminished. Thus, the instructors suggested revising the physical demand stressor to explicitly include mental demand as well, as they often go hand and hand. With this modification, the four initial stressors were retained in the final framework.

Through further discussion, two additional stressors were identified that were not included in the initial list. Specifically, instructors discussed the communication challenges that occurred when working with unfamiliar unit members. Whether due to new members joining an already intact unit, or a newly-trained, first-time deployed unit, *working with unfamiliar team members* was suggested as an additional stressor. The lack of cohesion, trust, and shared knowledge that come along with a lack of familiarity adds stress to a unit, especially when facing situations containing heightened threat levels. Additionally, communications among unfamiliar team members are likely to be different than communications between familiar team members, as unfamiliar units require more explicit communication and coordination which can be inefficient and demanding in high stress situations (Entin & Serfaty, 1999).

The second new stressor that emerged from this workshop focused on the issue of *broken communications*. Specifically, this stressor refers to any impediment to the team's ability to effectively communicate information. This includes spotty radio transmissions and ambient noise that occurs during firefights. The instructors carefully distinguished this from a complete lack of communications ("no comms"), noting that units typically have contingency plans for when communication fails completely. In contrast, communications that are only partially interrupted can serve as a specific source of stress, as team members remain committed to these communications that are not adequately effective. Such broken communications can cause the quality of information communicated, as well as other characteristics of communication (e.g., information flow, confirmation and response), to suffer.

As a result of this feedback, the final framework now includes six situational stressors: uncertainty, risk, time demand, physical and/or mental demand, lack of unit familiarity, and broken communications. Table 4 lists the six situational stressors, along with updated descriptions and additional examples.

Table 4. Final Set of Situational Stressors with Examples

Situational Stressor	Description	Examples
Uncertainty	*Unpredictable, novel, dynamic*	• Lack of details for operation; undefined mission parameters; lack of/conflicting intel • Failed communication between assets/ elements • Developing situational picture • Language and/or cultural barriers • Change in expected or planned tasking/ situation (e.g., bridge is out; planned route won't work for some reason) • New enemy threat • New area of operations (AO)
Risk	*Relatively unsafe, threat presence*	• New area of operations (AO) • Found IED or IED exploded • Taking fire or receiving contact • Suicide bomber • Counter sniper/sniper • Leaving an area
Time Demand	*Limited time to plan, think, act*	• Emergent issues or problems • High risk situations • Coordinating fires or assets (e.g., CAS, indirect fire) • Coordinated mission with other units
Physical/ Mental Demand	*Threat of exhaustion, fatigue*	• Difficult climate/ time of year (i.e., hot weather) • Distance of movement (e.g., 1km vs. 5km vs. 10km) • Amount of gear or weight of load • Strenuous terrain • Length of deployment (longer deployment = greater fatigue)
Lack of Unit Familiarity	*Level of familiarity, cohesion, trust, knowledge*	• Newly trained unit, first deployment • Intact unit with new members • Unit that has trust or cohesion problems due to past behavior • Unit with poor understanding of each other's roles; poor shared vision
Broken Comms	*Threats to the ability to communicate*	• Auditory exclusion • Spotty comms • Ambient noise • Taking fire

Model of Communication under Stress

Through the literature review and discussions with Marine Corps SMEs, it became apparent that context impacts communication; that is, the situation determines what good communication "looks like." The stressors and principles interact in such a way that different combinations of stressors (e.g., high risk, high uncertainty) may result in different threats to communication. This complexity confirms the importance of designing training that teaches individuals to consider situational stressors, and their potential influence on communications, both before and during a mission. Such planning can help the unit proactively and reactively adapt communication to best fit a given situation. Analysis of the situation and related communication strategies requires elevated levels of critical thinking and related cognitive skills. Thus, it is important that team communication training imparts a deep principle-based understanding of how communication can be affected by situational stressors. With this knowledge, leaders can recognize stressors and help units adapt communication beyond the limits of specific examples and rules.

The research team used a dual method approach to gain a better understanding of the connections between stressors and communication principles. To gain an operational perspective, the team engaged in discussions with three Marine Corps instructors (during the workshop discussed previously), a retired Marine Corps Master Sergeant, a retired Marine Corps Major, and a retired Army Master Sergeant. The research team facilitated several knowledge

elicitation exercises with the SMEs, asking them to consider questions about the communication problems that occur from elevated levels of situational stressors (e.g., *What happens to communication when uncertainty is high? How might each of the principles be affected?*). Drawing upon their prior experiences as well as example scenarios provided by the research team, SMEs provided input into the connections between the stressors and communication principles. A summary of these findings is presented in Table 5.

Table 5. Influence of Stressors on Communication – Operational Perspective

Situational Stressor	Overall Impact
Uncertainty	Uncertainty will lead to a focus on the tactical elements of the mission and can lead to a lack of initiative and mediocrity.
Risk	Risk leads to attentional narrowing, but individuals should also be mentally engaged in what is going on. They will try to simplify and prioritize communications, but focus will be narrow. May not be able to respond due to the conditions.
Time Demand	Time demand may lead to the narrowing of attention on the most important area, thus allowing for a very clear understanding of specific pieces of the situation, but loss of the big picture.
Physical and/or Mental Demand	Physical and mental demand are likely to lead to attentional narrowing as well as mental disengagement, as the body and mind begin to shut down to focus on the basics of surviving, the focus on communications lessens.
Lack of Unit Familiarity	A lack of unit familiarity can be associated with poorer shared understanding (i.e., understanding how other members think, act, react) and poorer cohesion/ trust as the members aren't familiar enough to have built that trust. Often, unfamiliar units are new, young units on first deployments, thus inexperience adds to the challenges facing unfamiliar teams.
Broken Comms	Broken comms can increase the chances that information is not getting to the intended recipients and can greatly impact the ability to maintain SA.

Additionally, the research team conducted an extensive literature search to provide scientific backing for these connections. Over one hundred articles related to team communications were reviewed, spanning several research domains (including organizational psychology, management, medical, and military personnel). A comprehensive table containing evidence for how each stressor may impact, or be associated with, one or more of the communication principles was derived from this literature. For utility in training, the results of the literature review were distilled down into a few high-level descriptive and prescriptive key points and recommendations. The team worked with Dr. Zaccaro to categorize key findings into two perspectives: (1) effects of stressors on the communication principles, and (2) effective communication in response to each stressor. The conclusions from the academic literature were then compared to the conclusions provided by SMEs. For example, SMEs noted that *Quality* and *Confirmation and Response* were two of the principles that were likely to suffer when time demand was high, which could negatively impact performance. Parker-Raley and colleagues (2013) found support for this conclusion, finding that teams who were able to communicate clearly (*Quality*) and acknowledge communications (*Confirmation and Response*) in a trauma situation (high time demand) were more effective. As another example, SMEs suggested that the quality of communications could suffer under physical or mental demand, due to the effects of fatigue (specifically, attentional narrowing). In an aircraft performance case study, Armentrout, Holland, O'Toole, and Ercoline (2006) found that fatigue contributed to more ambiguous (lower quality) communications, and in the end, an aircraft mishap. After comparing the takeaways from the literature with those of the SMEs, the final list of takeaways was identified and is presented in Table 6.

Table 6. Influence of Stressors on Communication – Final Training Recommendations

Stressor	This stressor leads to...	Under this stressor, units should...
Uncertainty	• Decreased understanding of what is *relevant* to communicate (especially for novices)	• Pass relevant information more frequently • Confirm and provide appropriate response to

Stressor	This stressor leads to...	Under this stressor, units should...
	• Sub-optimal *frequency* of communications, as unit members may either report everything or nothing at all • Poorer *quality* of communication as information is likely incomplete.	messages received • Share information throughout the network
Risk	• Narrowed attention, which could lead to less *frequent* and reduced *flow* of communications • Delayed or absent response to *request* for information, which could lead to decreased situation awareness and poor coordination • More *ambiguous or incomplete* information being communicated	• Send more timely situation updates • Communicate information that is relevant, accurate, and uses standard phraseology • Send updates to a broader network of individuals so everyone is aware of the situation
Time Demand	• Narrowed attention, leading to less *frequent* "regular" updates • Decreased *quality* of communications due to reduced time to gather complete information and to verify accuracy • Failure to consistently *confirm and respond* to messages being sent, due to time pressure	• Pass information more proactively to others (pushed, not pulled) to speed up decision-making • Pass relevant information more frequently so decisions and adjustments can be made more quickly • Confirm all communications coming through, but do so with brevity (e.g., "good copy")
Physical/ Mental Demand	• Less *frequent* communication due to narrowed attention and mental disengagement • Decreased *quality* of information being communicated • Very little information being *pushed* proactively	• Increase the role of the leader in managing and prompting communications from team • Focus on high priority information • Confirm receipt of messages consistently
Lack of Unit Familiarity	• Fewer instances of unit members *pushing information* proactively • More *frequent* communication overall due to more irrelevant information being passed and more requests being sent • More frequent *requests for clarification*	• Push information out to unit members before it is requested • Coordinate effectively with less frequent communication • Provide more appropriate responses the first time, needing fewer requests for clarification
Broken Comms	• Less *timely* (more delayed) communications are likely • Decreased *quality* of communications due to garbled or incomplete information	• Communicate only high priority information when spotty or unreliable comms are available • Confirm messages to ensure that information was received • Verify the accuracy and completeness of the received message

CONLUSION AND FUTURE APPLICATIONS

Using a multi-method, iterative design and evaluation process, the research team developed a theoretically-sound, operationally-relevant framework of communication principles and stressors that can be used by leaders and instructors, across situations, to better prepare, assess, and provide feedback to units, which will ultimately improve adaptive decision making. The team has produced a set of training materials based on this framework that have been vetted by both military and academic SMES. The training utilizes a blended learning approach that provides opportunities for trainees to explore, learn about, and practice applying the framework. A full training effectiveness evaluation (TEE) intended to validate the training content (i.e., the framework) and approach has been designed and will be conducted in the near future. The team also developed an observer-based assessment of unit communications based on this framework. The assessment is focused on the six communication principles, which leaders can use to track unit communication performance during a training exercise or live mission. Marine Corps and Army SMEs helped to develop, review and revise the assessment to ensure its practical utility in the operational environment.

Specifically, Marine feedback indicated that the communication assessment could help instructors and leaders: (1) make communication expectations explicit before a mission; (2) prime unit members to monitor communication during training; (3) assess communication performance after training; (4) provide more efficient and structured feedback about communication during debriefs; and (5) identify root causes of communication breakdowns (i.e., the *why*). Overall, the feedback from the target audience provides strong support for the relevance and usefulness of the developed framework for training and assessing unit communication in training and live environments.

ACKNOWLEDGEMENTS

This work was supported by the Office of Naval Research. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Office of Naval Research or the Department of Defense. This work was supported by the Office of Naval Research project N00014-12-G-0546 0004.

REFERENCES

Armentrout, J. J., Holland, D. A., OToole, K. J., & Ercoline, W. R. (2006). Fatigue and related human factors in the near crash of a large military aircraft. *Aviation, space, and environmental medicine, 77*(9), 963-970.

Bowers, C. A., Jentsch, F., Salas, E., & Braun, C. C. (1998). Analyzing communication sequences for team training needs assessment. *Human Factors, 40*, 672-679.

Burke, C. S., Stagl, K. C., Salas, E., Pierce, L., & Kendall, D. (2006). Understanding team adaptation: A conceptual analysis and model. *Journal of Applied Psychology, 9*, 1189-1207.

Cannon-Bowers, J. A., & Salas, E. (1998). Individual and team decision making under stress: Theoretical underpinnings. In J. A. Cannon-Bowers & E. Salas (Eds.), *Decision making under stress: Implications for individual and team training* (pp. 17-37). Washington, DC: American Psychological Association.

Entin, E.E and Serfaty, D. (1999). Adaptive team coordination. *Human Factors, 41*, 312-325.

Fiore, S. M., Smith-Jentsch, K. A., Salas, E., Warner, N., & Letsky, M. (2010). Toward an Understanding of Macrocognition in Teams: Developing and Defining Complex Collaborative Processes and Products. *Theoretical Issues in Ergonomic Science, 11*, 250-271.

Klein, G., Wiggins, S., & Dominguez, C. O. (2010). Team sensemaking. *Theoretical Issues in Ergonomics Science, 11*, 304-320.

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (1999). *To err is human*. Washington, DC: National Academies Press.

Liang, X., Ndofor, H. A., Priem, R. L., & Picken, J. C. (2010). Top management team communication networks, environmental uncertainty, and organizational performance: A contingency view. *Journal of Managerial Issues, 22*, 436-455.

Marks, M. A., Zaccaro, S. J., & Mathieu, J. E. (2000). Performance implications of leader briefings and team-interaction training for team adaptation to novel environments. *Journal of Applied Psychology, 85*, 971-986.

Parker-Raley, J., Cerroni, A., Mottet, T. P., Lawson, K. A., Duzinski, S. V., Mercado, M., & Yanez, K. (2013). Investigating pediatric trauma team communication effectiveness phase two: Achieving inter-rater reliability for the assessment of pediatric resuscitation communication team assessment. *Journal of Communication in Nursing, 6*, 145-157.

Smith-Jentsch, K. A., Zeisig, R. L., Acton, B., & McPherson, J. A. (1998). Team dimensional training: A strategy for guided team self-correction. In J. A. Cannon-Bowers & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training* (pp. 271-297). Washington, DC: American Psychological Association.

USMC. (August, 2011). *US Marine Corps Small Unit Decision-Making: January 2011 Workshop Final Report*. US Marine Corp Training and Education Command.

Waller, M. J. (1999). The timing of adaptive group responses to nonroutine events. *Academy of Management Journal, 42*(2), 127-137.

Wilson, K. A., Salas, E., Priest, H. A., & Andrews, D. (2007). Errors in the heat of battle: Taking a closer look at shared cognition breakdowns through teamwork. *Human Factors, 49*, 243-256.