

SHARED MINDFULNESS IN COCKPIT CRISIS SITUATIONS

An Exploratory Analysis

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Despite the high reliability of current aeronautical technology and safety improvements, human error continues to be a factor in 60% to 80% of all aviation mishaps. Training is often focused on analysis of faulty procedures or lack of procedures over a more systemic approach. This research explores the existence of the psychological construct of shared mindfulness and examines how it is communicatively constructed and enacted in a high-reliability environment. The qualitative study examines shared mindfulness in 10 aviation student dyads in a decision-making crisis situation to identify the communication behaviors of the construct and to determine whether shared mindfulness may lead to more effective pilot decisions. Findings reveal both the existence of shared mindfulness as a communicative construct and seven inductively derived communication process categories that create shared mindfulness in a dyadic situation. Those dyads demonstrating more communication behaviors of shared mindfulness also made the most effective decisions.

Keywords: *mindfulness; situational awareness; crisis communication; cockpit communication; dyadic interaction*

As our world grows increasingly complex, so do our organizational environments. Organizational members must deal with increasingly high levels of uncertainty, risk, and distraction. In times of crisis, when precious resources and lives totter between disaster and survival, individuals must be able to make sense and act quickly, yet heedfully with mindful attention. Perrow (1984) posited that crisis is associated with our growing technology and modern society's propensity to build more things "that can crash, burn and explode" (p. 9). Both the growth and our dependence on bigger, more elaborate systems contribute to increased crisis vulnerability (Sellnow & Seeger, 2001).

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Crisis is defined as

a specific, unexpected, and non-routine event or series of events that create high levels of uncertainty and threaten or are perceived to threaten high priority goals including security of life and property or the general individual or community well being. (Seeger, Sellnow, & Ulmer, 1998, p. 233)

Crisis initiates an instantaneous set of novel conditions that are driven by high levels of uncertainty about cause, blame, and consequences. Stress and fear about the future are pervasive and intense (Sellnow & Seeger, 2001). It is precisely in this type of environment that mindfulness is both riveted to attention by the novelty of a situation while simultaneously distracted by its immediateness, intensity, and pervasiveness.

Despite being highly reliable, the aviation industry is susceptible to crisis situations in which pilot/air crew/air traffic control must routinely perform error-free so as not to endanger the lives of those aboard the aircraft and on the ground. Unfortunately, aviation research has shown that poor or inadequate communication is a common contributor to errors in pilot or flight crew decision making (e.g., Beaty, 1995; Chute & Weiner, 1996; Palmer, Lack, & Lynch, 1995; Shappell & Weigmann, 1997; Snook, 2000). Research demonstrates that more than 70% of aviation mishaps are related to coordination and communication issues rather than a lack of technical skill (Lautman & Gallimore, 1987; Rufflesmith, 1979). Furthermore, in dual-piloted scenarios, error ratios have increased rather than decreased (Shappell & Wiegmann, 1996). Moreover, the industry acknowledges that the basic premise of crew resource management (CRM)¹ to reduce the number and severity of aircrew errors has been thwarted (Helmreich, Merritt, & Wilhelm, 1999). A focus on crew coordination and participation, if lacking in mindfulness, will not reduce error. Skitka, Mosier, Burdick, and Rosenblatt (2000) in an automation-related study of omission and commission errors found that a second crew member did not guard against automation bias, which is a reliance on the aircraft's automated control system decisions rather than verifying the automated commands against other available data. A second person in the cockpit did not decrease the tendency to incorrectly follow automated commands even when contradictory information was present. Moreover, performers equally failed to notice and respond to system irregularities when not prompted by the system. For example, the aircraft's automated system controls landing speed. However, in addition to the automated system information (which can malfunction), crew members have visual data with which to determine whether the landing speed is appropriate. Thus, if crew members work together well but not mindfully, the human error factor remains an issue and, in some instances, actually increases. Overall, this situation suggests that even a small improvement in crew interaction and communication will have a significant impact.

Moreover, the repetitive, ritualized nature of most aviation communication can foster error through mindless overuse of familiar communication patterns. Cushing

(1994) posited that it “induces a degree of ritualization, with statements and situations losing their cognitive impact and participants falling into a pattern of simply going through the motions for their own sake” (p. 46). Similarly, an analysis of en route operational errors and the impact of situational awareness of air traffic controllers revealed that “unaware” controllers were likely to make two particular communication errors: incorrect read-back of altitude information and failure to secure a pilot acknowledgment of receipt of information (Durso, Truitt, Hackworth, Crutchfield, & Manning, 1998).

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Communication and interpersonal interaction are significant factors in aviation error and subsequent pilot decisions in crisis situations. Although the aviation industry has invested heavily in training to improve crew resource management, the research statistics suggest there remains a missing element in improving overall effectiveness.

DEFINITIONAL ISSUES AND COMMUNICATION

Mindfulness is a psychological state in which individuals engage in active information processing while performing their current tasks such that they are actively analyzing, categorizing, and making distinctions in data (Langer, 1997). Langer and Moldoveanu (2000) espoused the notion of a mindfulness gap in which they assert that even surgeons and pilots are not immune to moments of mindlessness in their role performance.

Interestingly, the focus of prior research has been solely on individual mindfulness. Mindfulness is a recognized concept in communication with a significant body of previous research. It has been studied in such contexts as its impact on sense making (e.g., Weick 1995, 2001; Weick & Meader, 1993; Weick & Roberts, 1993; Weick & Sutcliffe, 2001); mindfulness/mindlessness in language and social interaction (e.g., Bevelas & Coates, 1992; Burgoon & Langer, 1993; Langer, 1992; Langer, Blank & Chanowitz, 1978); a psychological condition of personal engagement and disengagement at work (Kahn, 1990); and newcomer information-seeking behaviors (e.g., Casey, Miller, & Johnson, 1997; Louis, 1980; Miller, 1996). In addition, Burgoon, Berger, and Waldron (2000) studied the implications

of mindfulness in relation to several social issues such as reducing stereotyping and cross-cultural misunderstanding. Timmerman (2002) investigated the moderating effects of mindlessness or mindfulness on media richness and social influence. King and Sawyer (1998) examined mindfulness and mindlessness in message production during interpersonal encounters. This line of communication scholarship suggests that communication is germane to the construction of a mindful or mindless state.

However useful, past work in mindfulness research does not acknowledge the joint construction of a mindful state through the process of human interaction. To view mindfulness as it occurs within an interpersonal interaction, the elements of mindfulness as they relate to an involved state must be articulated. If mindfulness represents the active information processing at the individual intrapersonal level, shared mindfulness represents this activity at the interpersonal interaction level. Therefore, I propose the following definition: Shared mindfulness is a state of mindfulness achieved conjointly, whereby, in the communicative interaction, the individuals involved are in an active state of attending, responding, and perceiving information correctly. As a result, they are continually updating, attuned, and open to incoming data that are unexpected, disconfirming, improbable, implicit, and/or contested.

What is intriguing about mindfulness in relation to the aviation and communication research is, What would *shared* mindfulness look like? Furthermore, could shared mindfulness possibly be the missing element to effective CRM in reducing error in crisis situations?

The goal in the current study was to examine the construct of mindfulness as it is enacted through captain and first officer communication behaviors in crisis situations. The objective was to identify shared mindfulness in these dyadic situations and describe how it is communicatively constructed. To explore this objective, the following research question was posed for examination: What distinct communication behaviors might emerge in an aviation crisis situation to reveal shared mindfulness?

METHOD

The study involved 10 captain and first officer dyads composed of a voluntary sample of aviation students who participated in two crisis scenarios. Each dyad had 1 minute 45 seconds to read the crisis situation and a subsequent 2-minute discussion period to generate a decision response.

Setting and Participants

The research was conducted at a large midwestern university aviation center. The center is among the top-ranked training centers in the United States, with more than 900 students enrolled in its aviation programs. This setting was chosen be-

cause the aviation school primarily trains pilots and mechanics to become members of high-reliability organizations. According to aviation center officials, a majority of the student body will choose careers within the aviation industry as pilots with one of the major U.S. commercial airlines.

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Study participants were composed of a voluntary sample of 20 students (10 dyads) of the school's currently enrolled senior-year aviation student population in the Aviation Flight Science program Line Oriented Flight Training (LOFT) classes. This selection criterion was based on faculty and instructor assessments that senior-year students possess a richer repertoire of behaviors and more flight experience. Hence, they have sufficient knowledge and expertise to capably perform the assigned roles of captain and first officer. In particular, the LOFT classes were chosen because these classes are focused on CRM, which centers on crew interaction and communication. Participants were senior-level students in the aviation program. Of the 20 student participants, 18 were male and 2 were female, with 1 student of international origin with a non-English first language. The female participants were representative of the 7% total female population in the aviation program, and the international student was representative of the total international population of 3%.

A week prior to data collection, I attended both class sessions to announce the study and invite students to participate. At this session, students were informed the study's purpose was to identify the communication behaviors in crew interactions in a crisis situation to determine whether those communication behaviors have an impact on effective pilot decision outcomes. I also presented a brief description of the experiment stressing that participation was voluntary and would not affect their LOFT class grade. Students were provided an informed consent form to review in order to provide sufficient time to consider participation before the scheduled class the following week. To provide further incentive for participation, study volunteers would be eligible for a drawing of one winner of a \$50 American Express check.

Data Collection

Crisis scenario. The scenarios presented dilemmas that required participants to use communication behaviors to seek an appropriate solution within a compressed time frame, thus providing a set of environmental conditions designed to elicit either effective or ineffective participant interaction in a crisis setting. Two crisis scenarios were developed by one of the university's aviation instructors based on a typical senior-year aviation student's knowledge level and flight experience (see Appendix C for scenarios, decision options, and decision criteria). The content of each scenario was based on an actual incident reported in the National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) anonymous incident-reporting database. The instructor defined decision effectiveness criteria for each scenario. These particular scenarios had not been used at the aviation center prior to the current study. The first scenario depicted a flight situation in which an on-time departure is crucial despite adverse weather. The second scenario involved an in-flight engine failure with an inexperienced first officer onboard. In addition, the scenarios introduced elements that might provoke relationship conflict that could induce additional emotional and cognitive stress. For example, in the first scenario, an on-time departure is crucial for the crew's customer; consequently, conflict could arise if one views the customer's needs as primary and the other views those needs as jeopardizing flight safety. Thus, the objective of each scenario was to thrust the interactants into a novel situation, which could not be resolved via "checklist" procedures. In other words, the dilemma requires action outside of the scope of standard, routine procedures yet is still within the parameters of the knowledge and skill level of a senior-year student pilot.

Procedures

Prior to conducting the study, a pilot study was conducted with a senior-level dyad of comparable knowledge and skill level as the target study participants. The purpose of this pilot study was to test the research design procedures and refine the scenarios. As a result of the pilot study feedback, three changes were made to the study procedures. First, the time to read each scenario was shortened from 2 minutes to 1 minute and 45 seconds. The pilot dyad suggested this change because they believed it would allow sufficient time for the dyads to read the scenario but would prevent them from starting to think through what they would do before discussing it with their partner.

Second, the pilot study dyad suggested adding some distractions such as interrupting the crew as they were deliberating to more closely simulate the actual environment. For instance, other flight crew members such as a flight attendant could interrupt aircrews in a crisis situation. They also suggested adding other distrac-

tions such as noises and background talking. Finally, they suggested color coding the scenarios and instructions to facilitate efficiency and to avoid any confusion. All three suggestions were implemented into the research study procedures.

Data collection. Data collection was conducted in a separate classroom with the researcher as crisis scenario administrator and a videographer to record each dyadic interaction. The scenario administrator randomly assigned the role of captain and first officer to participants. Each dyad participated in both crisis scenarios. They were given 1 minute and 45 seconds to read the scenario and take notes. The role assignment was followed by a 2-minute videotaped interaction to generate a decision response to the crisis. A 2-minute time frame was selected based on the premise that it provides sufficient time to initiate interaction and discussion while retaining a sense of immediacy and the urgency to act. Thus, to simulate these physiological and psychological aspects of a crisis environment, the time frame was significantly compressed to induce elements of stress such that the interactants feel pressured to make decisions and act quickly with little information. A 2-minute timer was visible in the background as the dyads interacted.

This process was repeated for the second scenario. The scenario administrator assigned each participant the opposite role played in Scenario 1. The rationale for role switching is to determine whether participants demonstrate more or less mindfulness in playing one role over the other. All dyad interactions were videotaped and transcribed by the researcher. Transcribing the tapes yielded 37 pages of single-spaced data, which were qualitatively analyzed for major themes.

Data analysis. Analysis of the data followed the grounded theory approach (Charmaz, 2000; Strauss & Corbin, 1990). The main feature of this approach involves a “method of constant comparative analysis” (Glaser & Strauss, 1967, p. vii). The classic steps of grounded theory research were followed: coding data, developing inductive categories, revising, and condensing the initial categories together with Charmaz’s writing memos to explore preliminary ideas and reflections. The coding process generated 24 themes that were reduced to seven process categories of communication behaviors of shared mindfulness as well as subprocess categories for each category.

Subsequently, a thematic memo was created for each process category, explicating category and subprocess category definitions, communication behavior descriptions, exemplary quotes, and reflective comments to support the theme. Throughout this process, I compared observations of participant interactions against each other and the initial framework of characteristics of shared mindfulness, continually returning to the data to determine any new themes or unifying properties. Finally, data were categorized into a typology of shared mindfulness communication behaviors.

RESULTS

This study sought to explore the existence of the concept of shared mindfulness and identify the communication behaviors associated with this psychological construct. To achieve these objectives, communication in an aviation crisis context was viewed outside of the bounded episodes of performing routine procedures. Findings of the 20 aviation dyadic interactions indicate that shared mindfulness does exist under some conditions and that the presence of shared mindfulness is contingent on the enactment of specific communication behaviors.

The Construction of Shared Mindfulness in a Crisis Situation

Seven communication categories comprising the construct of shared mindfulness emerged from the data. These seven inductively conceptualized categories depict the communication behaviors associated with the construction of shared mindfulness in a dyadic interaction: (a) seeks information, (b) reasons from a positive perspective, (c) perceives multiple perspectives, (d) projects thoughts and feelings, (e) mindfully acknowledges partner communication, (f) uses participative language, and (g) demonstrates fluid turn taking (see Appendix A for a typology of the seven categories, subprocesses, and definitions).

Although identified individually, the communication process categories exist interdependently with some overlapping and, at times, are present simultaneously. Furthermore, the results showed that primarily three conditions inhibited the formation of shared mindfulness in an interaction: *precognitive commitment*, *overt dominance*, and *nonpositive reasoning strategies* (see Appendix B for a glossary of mindfulness inhibitors). Overall, 3 of the 10 dyads made the most effective decisions in both scenarios. Likewise, analysis of the dyadic interactions revealed that those same dyads demonstrated more communication behaviors of shared mindfulness than the dyads that made less effective decisions (see Table 1).

In reviewing the seven communication process categories that emerged from the data, in four of the seven categories, more than half of the shared mindfulness communication behaviors identified in the dyadic interactions were attributed to the interactants in Dyads 5, 6, and 7, the three most effective decision makers. Particularly salient is that 75% of the reasoning from positive perspective communication behaviors, 86% of the turn-taking behaviors, 52% of perceiving multiple perspectives behaviors, and 52% of projecting thoughts and feelings behaviors of the total number of dyads are represented within Dyads 5, 6, and 7. This finding is particularly important because a positive reasoning perspective was the most critical factor to fostering shared mindfulness. Moreover, this limited quantitative perspective lends support to the qualitative findings suggesting that the communication behaviors of shared mindfulness identified in the dyadic interactions lead to more effective decision outcomes.

Table 1 Dyad Decision Effectiveness Matrix

<i>Dyad</i>	<i>Decision Options</i>				
	<i>Scenario 1</i>			<i>Scenario 2</i>	
	<i>1—Effective</i>	<i>2—Less Effective</i>	<i>3—Ineffective</i>	<i>1—Effective</i>	<i>2—Ineffective</i>
1	1				2
2			3		2
3		2		1	
4		2			2
5	1			1	
6	1			1	
7	1			1	
8		2			2
9	1				2
10		2		1	

Generally, shared mindfulness was facilitated in an interaction to the degree that both interactants actively engaged in a number of the communication behaviors of shared mindfulness. If one interactant displayed one or more of the behaviors, whereas the other interactant did not, it led to a shared mindless state in which important information was put forth into the discussion but was left unprocessed. Subsequently, this information was not used to deliberate, which significantly impeded the dyad's ability to make an effective decision.

DISCUSSION

This section summarizes the seven communication behaviors of shared mindfulness into four key factors that appear to have the most significant impact on whether shared mindfulness was created within an interaction. Also discussed in this section are various inhibitors, patterns, connections, and missing links that emerged from the data. Furthermore, shared mindfulness is considered as a bridge between the decision process and decision quality. Finally, the extent to which shared mindfulness is a unique concept is presented.

Key Factors That Affect Shared Mindfulness

The results of this study point to several overall key facilitators of shared mindfulness in an interaction as well as identify the primary inhibitors within an aviation context that sabotage it. We can better understand how shared mindfulness may be connected to effective decision-making outcomes by exploring the following factors: (a) reasoning from a positive perspective; (b) using a kaleidoscopic perspective; (c) speaking thoughts and feelings aloud, precisely, and conditionally; and (c)

acknowledging communication substantively. However, the presence of the following behaviors either significantly hindered or precluded the formation of shared mindfulness in an interaction: (a) precognitive commitment, (b) nonpositive reasoning strategies, and (c) overt dominance. Next, each of the above shared mindfulness facilitators is addressed separately. Specific inhibitors are addressed as points of contrast to the facilitator being discussed.

Reasoning from a positive perspective. The perspective from which interactants reasoned was the single most important factor in whether shared mindfulness was facilitated in the interaction. As the study findings illustrate, if interactants reasoned from a positive perspective, they noticed and incorporated both discrepant and disconfirming information. This behavior was especially paramount if either interactant had engaged in precognitive commitment because using a positive reasoning strategy helped the dyad remain open to changing their initial decision option in view of the discrepant and/or disconfirming information.

Conversely, if interactants reasoned from a negative perspective, they normally had engaged in precognitive commitment in which they had decided on a course of action based on one element as the primary evaluative criteria (i.e., the thunderstorm or emergency services) to the *exclusion* of other salient elements. Thus, they were less apt to notice discrepancy, disconfirming information, or alternative possibilities for action. Hence, as Langer (1997) and Timmerman (2002) argued, they were operating without a category system such that all information would fold into a single category (e.g., thunderstorm) from which classifications were made. After having encountered the new situation without actively attempting to interpret the details, they perceived only a single solution and mindlessly followed that option.

According to Weick and Sutcliffe (2001), in reasoning from a negative perspective, the interactants were not operating mindfully because they did not rework the ways they labeled and categorized what they saw. Rather, they discarded the information rather than process it and use it to further deliberate. In instances where one interactant used a positive reasoning strategy and the other a negative reasoning strategy, the person using a negative strategy was more likely to use nonfact-based reasoning, an emotional perspective, to support his or her position—particularly if overt dominance behaviors were present. In addition, he or she appeared unwilling to incorporate any discrepant or disconfirming information that would contradict the preferred course of action.

These positive and negative thought patterns are similar to what Manz (1992) suggested as *opportunity* thinking and *obstacle* thinking. Whereas opportunity thinking focuses on opportunities, beneficial challenges, and constructive patterns of dealing with trying situations, obstacle thinking is focused on negative aspects such as reasons to give up or retreat from a problem altogether.

The following dyad's (Dyad 4, Scenario 2) decision-making discussion provides a telling example that illustrates a full spectrum of facilitative and inhibitive

communication behaviors (i.e., mixed reasoning strategies, precognitive commitment, overt dominance) that affected the formation of shared mindfulness in this interaction. This dyad ultimately made the ineffective decision to attempt to make it to the major airfield.

The captain was reasoning from a positive perspective considering both the available information and the discrepant information that was potentially disconfirming. Furthermore, the captain acknowledged all of the first officer's statements whether he agreed with them or not; moreover, he accepted her information and used it to change his decision (even though he had actually proposed the most effective option). But, unfortunately, he did not question her further about information she rejected, such as the headwind, which might have reversed the decision in his favor. However, the first officer was reasoning from a negative perspective; she used nonfact-based reasoning, supporting her position by focusing on one element that was lacking, the emergency services at the smaller glider field. The first officer did not acknowledge some of the captain's questions or appear to take in information that contradicted her position (landing at the major airport). She made up her mind very early (precognitive commitment) and did not change her position based on any additional information from the captain.

This was a very interesting interaction from an overt dominance perspective. The captain clearly dominated the conversation verbally and nonverbally. He used several nonverbal power strategies such as maintaining eye contact, taking up a larger space, and talking loudly but in a very measured tone. He invaded the first officer's space and used intimidation tactics by using a sarcastic tone at times and using his pen to wave it in her face.

On the other hand, the first officer, although her nonverbal communication indicated she was intimidated by the captain (i.e., her downward glance, her nervous hand movements confined to a restricted space away from the captain), she readily verbalized her disagreement and used overt dominance behaviors such as talkovers and nonacknowledgment of her partner's communication. As this was a male-female dyad with the female person in the first officer subordinate role, what, if any, gender and/or role nuances might have been present is unclear. Not surprisingly, this dyad made the ineffective decision to land at the major airport. The captain begins the discussion from a positive perspective, providing an overview of the available information.

Captain: Alright, this is the situation. (*Speaking forcefully*) Our engines are out, they are not restarting, we are at 31,000 ft (*using hand gestures for emphasis*), and the small airport is 30 miles (*points in front of him with pen*) that way and we can get there within gliding range (*first officer nodding affirmatively at different points, indicating attentive listening*).

The first officer begins reasoning from a negative perspective looking only at what is lacking.

First officer: But we aren't going to have any emergency vehicles or any emergency services when we get there (*says strongly while pointing her finger in the direction they have decided is the virtual airport under discussion*).

Again, the captain brings into the discussion positive information.

Captain: But you have glider experience (*again forcefully looking directly at the first officer and pointing his pen for emphasis*).

First officer: Right.

Captain: (*Available Information/Disconfirming Information*) So you know how to glide this thing right down in there because you've done it before (*again very forcefully and pointing his pen toward the first officer and then pointing to the virtual airport where she would land*). Or (*emphasis*) we could go to the major airport (*pause*), but we might not make it (*again pointing his pen in staccato movements in the air in the same rhythm as his words*). I say we go to the small airport (*points to the virtual airport, smiles; looks directly at the first officer*). What do you think?

The first officer has engaged in precognitive commitment in which she is beginning to view all information through a single lens, the emergency services, folding all information into that category.

First officer: I would say go to the large airport (*[looking directly at the captain], her voice is measured but sure and getting a little higher pitched*).

Captain: You want to go to the large one?

First officer: (*Available Information*) Because we have all those emergency services waiting for us (*spreads out her hands*).

The captain brings in discrepant information about a headwind component along with disconfirming information that they might not make it to the major airport. However, the first officer does not accept this input and will only look at information that supports landing at the large airport. At this juncture, the captain's verbal and nonverbal behaviors become increasingly dominant. The first officer's verbal and nonverbal behaviors are outwardly more submissive but yet are defiant. She is sending an incongruent verbal and/or nonverbal message to the captain. After several more attempts to incorporate the discrepant and the disconfirming information, the captain changes his decision after forcing the issue with the first officer to acknowledge that she does not want to land at the small, glider field.

As illustrated in the above description and excerpt, precognitive commitment seemed to be the most frequent cause of interactants choosing an alternative reasoning strategy from which to support their position. Furthermore, I noted a subcategory of precognitive commitment referred to as a *quick-decision mentality* rather than a *right-decision mentality*. Individuals who engaged in this phenomenon appeared to focus solely on the *time element* of the crisis situation such that they were more concerned with making a quick decision before any or sufficient discus-

sion with their partner rather than a right decision by adequately and accurately assessing the situation. Therefore, these individuals immediately decided on a course of action and reasoned solely from this option, not accepting or processing alternative courses of action.

Several dyads used a positive reasoning strategy very effectively. For example, Dyad 6, Scenario 2, illustrates how interactants reason from a positive perspective by using the available information that the small glider field is within gliding range and that the alternative, the major airfield, may not be because of the headwind component. Afterward, they introduce both disconfirming and discrepant information to compare the options and ultimately choose the most effective option—the glider field.

Captain: (*Available Information*) I'd say that's definitely within the gliding range. The other one might be outside the gliding range because of that headwind component. I'd say stick with the best field you've got and make a nice, easy landing on it.

First officer: (*Introduces Disconfirming Information*) I've seen the field before, and I agree to make a landing there if we are sure we can make it.

Captain: (*Incorporates Disconfirming Information*) The type of plane will go in there (*demonstrates with his left hand an airplane landing*).

First officer: (*Discrepant Information*) Yeah, I think we have enough runway there. I think we can make a safe landing—so I'm not concerned.

Captain: (*Available Information*) "It's got a 3,000 ft. cloud base; you've been there; you've got gliding experience. It might be pretty good. You've been practicing those power off 180's (*uses a hand gesture to indicate the type of landing*).

First officer: Yeah.

Captain: You're pretty good at it.

First officer: (*Comparing Options*) If we make good on the landing, we don't need all those emergency services.

Captain: (*Comparing Options*) A safe landing here would be better than an emergency landing at a major airport trying to get to threshold and landing short.

In addition, I noticed a pattern that when interactants reasoned from a positive perspective, their decision explication contained more detailed fact-supported reasons for their decision. For instance, the above discussion yielded the following decision explication (Dyad 6, Scenario 2, Decision).

Captain: Our decision will be to go to the smaller civilian airport because we believe it's a smaller aircraft we're flying that can land on that strip. Since he's (*first officer*) familiar with the airport and believes that's doable. It has a 3,000 foot cloud base so it's got a nice base to it, and we can call up civilian authorities on the ground and maybe get some assistance if it's needed. But gliding from 31,000 feet, we have plenty of time to dump any fuel that we need to and set up for it appropriately; make sure (*that*) we are in the right spot; plenty of time to restart the engines without trying to strain the aircraft; figure a nice safe landing at a small airport is better than a . . . (*first officer finds the word*) . . . stretching it (*captain continues*) . . . than a stretched crashed landing short of a major (*airport*).

Dyads that used a positive reasoning strategy in the deliberative process not only demonstrated more openness to noticing and incorporating discrepant and disconfirming information but also tended to compare and contrast potential decision options. Dyads using alternative strategies were much less likely to engage in comparing and contrasting the decision options. Most often, because they had engaged in precognitive commitment and had determined a sole solution then mindlessly followed that option.

Interestingly, overt dominance behaviors appeared to hinder the creation of shared mindfulness even in the presence of positive reasoning because these behaviors stifle the other party's full participation; and discrepant or disconfirming information, although recognized, is not incorporated into the decision-making criteria. Therefore, the interactants' decision-making quality was negatively affected because they were not using all the information available to them to make the best decision. For example, in Dyad 3, Scenario 1, the first officer tries three times to engage the captain in seeking discrepant information after they have made their decision (the less effective option to depart on runway 08). After the second instance, the captain responds facetiously in a sarcastic tone, "After you've asked me twice!" Consequently, he refuses to engage in further information seeking or accept input from the first officer regarding his concerns about the decision. Interestingly, when the pilot and/or first officer roles are reversed, this dyad makes the most effective decision. In the second scenario, the pilot requests the first officer's input by inquiring, "What do you think?" and incorporates that input into the deliberative process. When an interactant was interrupted or talked-over midsentence and did not finish the thought, then, many times, that idea was lost. Unfortunately, that information might have been vital, discrepant, or disconfirming information but remained "unprocessed" and consequently, could not be used to deliberate.

Using a kaleidoscopic perspective. Interactants who adeptly perceived multiple perspectives were the most cognizant of, and most accurately depicted, the current state. Although the ability to perceive multiple perspectives was a powerful element in creating shared mindfulness, it was significantly absent within the interactions. One reason why this behavior was not as evident might be due to the extensive routine, procedural-type training of flight crews in which they learn specific behaviors and task sequences in which there is a sole, predefined solution and only one "right" way to accomplish the task. Consequently, for the most part, flight crews do not engage in viewing situations, problems, or environments from a variegated perspective because most routine situations and environments contain a preset protocol of requisite behaviors and procedures. After multiple iterations of these "scripted" routines, when confronted with a unique, unscripted situation, it may be they are depending on their existing categories from which to view the novel stimuli. For instance, in the first scenario, 4 of the 10 dyads chose the less effective decision to depart from runway 08. The aviation instructor in developing the decision effectiveness criteria notes that because the aviation student participants lack experience with thunderstorms,

they will most likely choose this option because the winds are within limits. In essence, they will tend to categorize all information within an existing, familiar category rather than look at the novelty of the situation and look outside of that category for possible alternative options.

Overt dominance behaviors appeared to hinder the creation of shared mindfulness even in the presence of positive reasoning because these behaviors stifle the other party's full participation.

Those with the ability to see multiple perspectives were able to cognitively recognize the current state as outside the parameters of a script and consequently mentally acknowledged the novelty of the situation that prompted them to begin looking outside of their existing categorized schemas for the most effective option. In a study involving drawing distinctions about classical music, rap, a football game, and paintings, Brown and Langer (cited in Langer, 1992) found that considering multiple perspectives (in the form of drawing novel distinctions) resulted in improved retention and better liking of the target information. In a crisis situation, recalling critical pieces of information is crucial to making an effective decision.

Similarly, as Weick (1993) explained in the case of the Mann Gulch incident, 13 smoke jumpers died because they did not recognize until it was too late that they were not fighting the normal 10:00 fire (one that can be encircled and totally confined by 10:00 a.m. the following day). Their leader, Wag Dodge, did recognize it as a dangerous, nonroutine fire. On the basis of the uniqueness of the situation, he looked outside of his existing categories of firefighting knowledge and found a novel option that was unknown at that time; he built an escape fire. He used his knowledge of fires—that they require a flammable material, and in those few seconds, he extrapolated beyond that knowledge and came up with a novel idea to remove the flammable material by burning it before the fire reached them, thereby lessening the heat intensity. But when he ordered the men to lie down in the escape fire, they refused and ran. Thirteen of the 15 who fled perished in the fire. Those who fled could not get beyond their categorized, scripted knowledge of firefighting and recognize that the current reality demanded a novel response.

Dyad 6, Scenario 1 illustrates how interactants perceived possibilities and choices beyond a single course of action or sole solution to a problem. Interactants initially perceived both options, runway 08 and runway 26, as possible choices. They used the available information of the departure time, tailwind, taxi time, and the thunderstorm and incorporated the discrepant information, which was whether they could start taxiing within 5 minutes. Then they compared the available and dis-

crepant information against the proposed options to choose the takeoff runway. They chose the most effective option—a departure off runway 26.

Captain: Alright, so basically our choices are to leave, to leave in under 10 minutes.

First officer: (*Available Information and Discrepant Information*) And start to taxi in 5 minutes, then we can make it through the tailwind landing, which is in our minimums. It's doable (*runway 08*) as long as we are ready to taxi in 5 minutes.

Captain: (*Incorporates Discrepant Information*) But then there's the thunderstorms 2 to 3 miles out there one way. . . . So . . . so we can either taxi out there to get away from the thunderstorm, or . . . which will make a longer taxing time; but we want to get off before.

First officer: (*Uses Discrepant Information to Compare Options*) So we can start taxing in 5 minutes or take (*runway*) 26 without missing the thunderstorms, or be delayed 5 minutes and miss the thunderstorms.

Captain: I'd say if we are ready to taxi, let's (*do it*).

First officer: Yeah, we might as well go taxi out (*on runway 26*); get everyone there; everyone's happy, as long as we are ready to taxi rather than be delayed.

Unfortunately, the majority of interactants, with scripted behavior precluded because of the novelty of the crisis scenario, resorted to precognitive commitment, folding most of the information into one category (e.g., timing issue, availability of emergency services), and based their reasoning on this one salient factor to the degree that they folded all other information into that category and information that did not fit was simply discarded. When the captain questions the first officer after they decide to land at the major airport, "What happens if we don't make it?" neither interactant actively processed this information because it did not fit into the category of their decision criteria for choosing the major airport. Amazingly, they just discarded the information, thereby increasing the likelihood of a catastrophic error in judgment that might result in a crash landing short of the major airport. As a consequence, in the presence of disconfirming data, interactants normally did not change their decision.

The outcome of *not* perceiving multiple perspectives is that interactants engage in two behaviors that Langer (1997) describes as strongly inhibiting mindfulness: premature cognitive (precognitive) commitment and an overdependence on existing categories, which causes the interactants to disregard critical information.

Speaking thoughts and feelings aloud, precisely, and conditionally. The most important impact of interactants speaking their thoughts and feelings aloud using precise, concrete terms was that it led to mutual understanding quickly, which is critical in a crisis situation. This type of "thinking aloud" allowed the other interactant to see and/or experience the partner's thought processes in real time. This fostered mutual understanding from the perspective of having a base knowledge of where the other person was coming from in his or her reasoning so that conclusions drawn from the reasoning were more credible and plausible.

Individuals who actively engaged in this activity demonstrated a greater propensity to construct an ad hoc procedure in which they walked through the steps of reconstructing the tasks required to accomplish the decision option. In addition, they appeared more apt to notice discrepant and disconfirming information and incorporate it into their plausible scenario planning. Thus, those dyads who actively voiced their thoughts and feelings created the most accurate depiction of the current state as well as the projected state because they mentally constructed it by verbally walking through the reconstruction of the tasks to achieve it. In doing so, they became aware of what was lacking or prohibitive to successfully accomplishing the goal. This aspect of perceiving multiple perspectives is most closely related to aviation's situational awareness in which individuals perceive and comprehend the meaning of the elements in an environment and can project their short-term future status. Using this awareness, Weick and Sutcliffe (2001) contended that individuals fluidly make adjustments that impede errors from accumulating and enlarging. Research in the area of thinking aloud pair problem solving (TAPPS) supports this supposition. A fundamental element of TAPPS is verbalization. The technique is based on the premise that when working dyadically, verbalization of inner thoughts makes explicit the problem-solving reasoning of the interactants, thereby helping them to monitor their reasoning and identify errors.

In a study of the effect of TAPPS on troubleshooting ability using aviation technician students, Johnson and Chung (1999) found that TAPPS pairs solved 34 problems in 4 hours versus 30 problems in 5 hours for the non-TAPPS pairs. Overall results indicated those dyads using the TAPPS strategy completed the problem-solving task in a shorter time period. Furthermore, they solved individual problems within the task in less time while gaining more experience in solving problems than pairs not using the technique. Moreover, there was a significant difference in the ability of TAPPS dyads to *recognize* the existence of faults in the system.

Although a number of interactants in the current study demonstrated the behavior of speaking their thoughts and feelings aloud, in many instances it was not effective for two reasons. If interactants voiced their thoughts in a hesitant or questioning manner, it did not facilitate shared mindfulness in the interaction as the other interactant did not appear to accept or process or give credence to information when presented in this manner; consequently he or she did not incorporate the information into the decision deliberation process. Second, if interactants did not verbalize their thoughts and feelings in precise, concrete language, ease of understanding was not achieved. To illustrate, Dyad 7, Scenario 2, within the same interaction, this captain speaks his thoughts aloud in one instance precisely and in the second instance, imprecisely.

Precise:

Captain: Okay, we are at 3,1000 ft; it doesn't say anything about the glide range. And let's see (*pause*) it's 30 miles from the nearest field. One mile per gliding per thousand feet. 3,000-ft ceiling—looks like a crappy situation.

Imprecise:

Captain: But if we have a major headwind and not too much gliding experience . . . trying to reach that other thing (*major airport?*) that's a problem (*scratches the back of his head and looks at the first officer; the first officer rests his eyes on the captain's notepad but nods affirmatively*) I mean think about . . . it says we have a headwind component.

As illustrated above, projecting one's thoughts and feelings aloud without couching these statements in precise, concrete terms makes it much more difficult to achieve mutual understanding. For instance, the ambiguous phrase, "trying to reach that other thing" could have been interpreted in a number of ways by the first officer, so it is not precisely clear what the captain is referring to in this statement.

In an aviation context, it is particularly important to use precise, concrete, standard terms so that an accurate description of the human and environmental conditions is presented. This is similar to the medical field in which a medical doctor conducting a surgical procedure must use precise, concrete, standard terms so that there is no confusion or misunderstanding among the medical team that might precipitate a potential fatal error to the patient undergoing the operation.

Using conditional language acknowledges the temporary, ever-changing nature of environmental conditions, and thus it seemed to prompt mindfulness on the part of the interactants. It was especially crucial for the captain to use conditional and inclusive (we) language, particularly in the situational analysis phase, as the captain and first officer were less likely to engage in precognitive commitment in which they would fold all information into one category and fail to make critical distinctions or notice discrepancies and inconsistencies that could prove to be fatal errors.

Burgoon, Berger, and Waldron (2000) identified conditional thought processes as one of three communicative relationships conducive to mindfulness in social interactions. The use of conditional language initiates mindfulness because it stimulates interactants to notice discrepancies and inconsistencies. Furthermore, introducing information conditionally has been found to prompt individuals to use that information in a creative manner (Langer, 1992), a potentially life-saving ability in a nonscripted crisis situation.

Moreover, in the presence of overt dominance, conditional language can be used as an assertive but nonthreatening communicative tool. For example, in Dyad 5, Scenario 1, the captain displayed particularly dominant communication behaviors. He makes an initial decision to depart on runway 26 to avoid the thunderstorms and then requests input from the first officer. The first officer agrees with the captain's assessment and decision but provides a caveat in conditional terms.

No, I agree the thunderstorm is two to three miles away and there's plenty of time to get out of its way. [But] if it takes longer to taxi because of the thunderstorm, Airforce One may be upon the airport by the time we are ready to take off.

The conditional language of the first officer's response is nonthreatening but simultaneously alerts the captain to a potential issue in regard to the chosen decision option. Thus, the captain responds, "Yes, that's the same question I was thinking too. The thunderstorm could be moving faster, and something could happen along our taxiway."

From a hierarchical perspective, using conditional language on the part of the captain appeared to "level the playing field" and create a nondefensive environment such that it provided space for the subordinate to disagree or voice an alternative viewpoint. On the part of the subordinate, using conditional language was an assertive but nonthreatening approach to presenting one's input or opinion.

Acknowledging communication substantively. Although acknowledgment was the communication behavior exhibited most often in the study interactions (72 occurrences), most of those instances were simple acknowledgment (yes/no) rather than substantive. For the most part, interactants demonstrated acknowledgment of partner communication, but what was lacking was mindful acknowledgment that would be conducive to creating shared mindfulness. Mindful acknowledgment not only acknowledges the communication but responds to the substance of the message communicated, demonstrating that the partner has perceived and critically processed the intended meaning of the message. However, interactants primarily engaged in mindless acknowledgment in which they merely acknowledged that they heard the message but not that they had critically processed it to ensure understanding so that they could use that information to further deliberate.

Mindless acknowledgment was observed in three forms:

1. *Lack of critical thinking:* Partner communication is acknowledged, but the interactants are not perceiving the environment accurately because they do not seek out any discrepant or disconfirming information; hence, they are communicating without using critical thinking skills.
2. *Tangential response:* The interactant acknowledges the other's communication but does not respond to the substance of that communication.
3. *Dominance:* One interactant is displaying overt dominance and pressuring the partner into agreement.

The result of mindless acknowledgment was that the interactants would achieve congruence in their thought patterns, but it was shared mindlessness. As illustration, Dyad 2, Scenario 2 created shared mindlessness in which they did not perceive the environment accurately because they did not process the disconfirming information; for example, there was a headwind, which meant they might not make it to the large airport. In addition, they did not actively process the discrepant information. They did not know the size of the glider field; they just guessed. Furthermore, they did not know the size of the plane. Thoughtlessly, they make no attempt to factor these elements into the decision criteria.

- Captain: You know the gliding field. But, personally, I wouldn't want to land a big plane at a glider airport.
- First officer: Yeah. Are we going to land a 777 at Newcastle? (*spoken in a sarcastic tone because it is a very small airfield*)
- Captain: No, not really, and it says it's 5 minutes out of gliding range, and there is a headwind component; but, I would rather go to the emergency field (*the large airport*).

Dyad 7, Scenario 1, provides a good illustration of a sequence of acknowledgment that includes both simple and substantive patterns. These behaviors trigger information processing such that the interactants engage in information-seeking behaviors that surface critical information into the deliberation process.

- Captain: Alright, what do you think? There's a thunderstorm 2 to 3 miles out.
- First officer: (*Acknowledgment and processes information*) We have to come around here real quick (*uses his pen to illustrate the path of the plane on his notepad*), and that way we'll save our taxi time to runway 08.
- Captain: (*Acknowledgment and processes information*) That's a problem; too much crosswind (*simultaneously shaking his head no*).
- First officer: (*Acknowledgment and processes information*) That's right; so we couldn't do that. So get here by 2:00 p.m. (*pointing to illustration on his notepad*). By 2:10 (*p.m.*) it's closed.
- Captain: So we have 15 minutes to taxi to runway 26.
- First officer: (*Acknowledgment*) OK.
- Captain: We'll have 5 minutes to see if the weather is still going.
- First officer: (*Acknowledgment*) OK (*looks puzzled*). Was there a question on this problem?
- Captain: (*Acknowledgment and processes information*) (*shakes head no*) . . . just to see what kind of scenario would work. So, I would say, taxi to runway 26; hold tight; see what the weather is doing, and within 5 minutes, we can make the departure if the thunderstorms move in.
- First officer: (*Acknowledgment and processes information*) We can take the departure and go back around that way (*points with his pen on his notepad*). I think that's perfect.
- Captain: That tailwind component—was that off 08?
- First officer: (*Acknowledgment and processes information*) (*Nods head affirmatively*). The wind is 260.
- Captain: (*Acknowledgment*) Correct.
- First officer: (*Acknowledgment*) OK. At 05.
- Captain: It will take 20 minutes to taxi down there maximum; sounds doable to me; let's do it! Gives us time for a cup of coffee then. Excellent.

Partner acknowledgment of communication not only helped the flow of communication in an interaction but also appeared to initiate the processing and incorporating of the information into the deliberation process. Otherwise, the information was "put out there" but remained unrecognized as input by both parties.

Mindful acknowledgment is a highly salient component in creating shared mindfulness in an interaction. The results suggest a pattern that if an interactant acknowledged his or her partner's communication via a substantive comment that demonstrated he or she not only heard what the other interactant said but was able to discern the intended meaning and verbalized that understanding, then shared mindfulness was facilitated. Thus, it appeared that to the degree interactants mindfully acknowledged each other's communication substantively, the higher the level of shared mindfulness was created in the interaction.

Results from this study indicate that shared mindfulness is not the same construct as the collective mind.

In summary, the results suggest that shared mindfulness exists under certain conditions and is enacted through a variety of complex communication behaviors. In an aviation context, in which the decision process is no longer a solo but a shared activity, shared mindfulness provides a means to connect the decision process to decision quality. Next, shared mindfulness as a unique concept is discussed.

Shared Mindfulness Versus Collective Mind

Weick and Roberts (1993), among other researchers (Brockmann & Anthony, 1998; Janis, 1972, 1983; Neck & Manz, 1994; Wegner, Giuliano, & Hertel, 1985), have studied collective mental processes and defined the collective mind as enacting a common environment in which individuals acquire a single transactive memory system in which each person is responsible for remembering his or her own part. In a transactive memory system, people retain related information in different locations such that when they exchange pieces of information, specific details and dissimilar ideas, they frequently perceive higher-level themes or generalizations that make the details and disparate pieces fit together. These collective mental processes are primarily enacted via the communication processes of the group members (Wegner et al., 1985).

Are shared mindfulness and the collective mind the same concept by a different name? Results from this study indicate that shared mindfulness is not the same construct as the collective mind. Rather, shared mindfulness is focused on individuals perceiving an *accurate* environment through sharing similar, disparate, discrepant, and disconfirming information via specific communication behaviors that facilitate a shared mindful state. The focus of shared mindfulness is accurate perception so that the environment enacted is current, precise, and factual. Collective mind, on

the other hand, is focused on a common environment based on how the individuals in the group define it. This is evident in Janis's (1972) research on groupthink in which the group defines the current environment, but it is based on the inaccurate perceptions of the individual members. In contrast, shared mindfulness is predicated on an accurate depiction of the environment via an attending state of perceiving that is continually open to incoming data.

Shared mindfulness is more akin to Weick and Roberts's (1993) definition of acting heedfully based on Ryle's (1949) explication, "People act heedfully when they act more or less carefully, critically, consistently, purposefully, attentively, studiously, vigilantly, conscientiously, pertinaciously" (p. 361). Weick and Roberts contend that the more individuals interpersonally act with heed, the more developed is the collective mind. The upshot is the greater capacity of the group to comprehend instantaneous unexpected events and to make better decisions. I submit that the interpersonal development of shared mindfulness is requisite in order for individuals to act with heed. In this capacity, shared mindfulness functions as the prerequisite for creating a collective mind that is based on accurate perceptions rather than a common environment.

CONCLUSION

Future Directions

Extending mindfulness theory. This study sought to explore a different perspective of mindfulness—the conjoint mindful state created through interaction, which has not been previously studied. Past research has indicated the psychological characteristics of the trait and state of mindfulness, yet researchers have not fully considered the importance of communication in the construction of mindfulness. The study findings support the extension of mindfulness theory from the individual cognitive level to the interpersonal communicative level and highlight the salience of symbolic interaction to the mindfulness process. The study findings indicate that shared mindfulness does exist and is constructed by individuals via specific communication behaviors.

Expanding the definition of mindfulness to include shared mindfulness opens new venues for expanding theory in terms of understanding how mindfulness operates at an interpersonal level. Increased knowledge and understanding of mindfulness as an interactively shared process can significantly affect multiple areas of import such as group performance, organizational communication, and decision-making processes. For example, this study's findings illustrate that shared mindfulness is an important factor to the enactment of effective decision making in crisis situations. Shared mindfulness may yield similar utility when exploring the decision-making activities of other types of organizational situations.

This research creates a communicative bridge from the cognitive construct of shared mindfulness to its enactment in the environment via discursive processes. As a consequence, the communication behaviors of shared mindfulness identified in this study directly translate the theoretical, conceptual framework into application. Future lines of interpersonal research in this area may include providing in-depth situated knowledge of how shared mindfulness is communicatively enacted in other dyadic situations as well as larger group contexts such as surgical teams.

The communication behaviors explicated in this study provide a rich repertoire of interpersonal communication tools to create shared meaning at an interaction level.

Perhaps most noteworthy, in high-reliability organizations such as the aviation, health care, and technology industries, extending mindfulness into shared mindfulness provides a venue to move beyond habitual, scripted performance in which each performance is merely a reproduction of the last. In mindful performance, every action is modified or varied as required based on the previous action (Ryle, 1949; Weick & Roberts, 1993). Consequently, rather than relying on drill and repetition, shared mindfulness at a communicative level allows individuals to conjointly create a current, precise, factual environment. The results of shared mindfulness have the potential to yield positive organizational and individual outcomes, such as reduced human error, increased performance, and higher quality-of-work production.

Implications of research findings to aviation crisis decisions. The communication behaviors explicated in this study provide a rich repertoire of interpersonal communication tools to create shared meaning at an interaction level. Ultimately, the enactment of these behaviors may create a shared mindful state that will enhance effective performance. One of the most important findings from this study is the centrality of dyadic reasoning to the facilitation of shared mindfulness. Overall, the three dyads that made the most effective decisions visibly and consistently exhibited positive reasoning behaviors during the crisis scenarios. This finding is particularly salient in affecting what Trollip and Jensen (1991) referred to as the *poor judgment chain*, which is the result of a series of bad decisions or errors rather than one bad decision.

Findings from the present study suggest that the perspective from which individuals reason during the decision-making interaction determines how open and

accepting they are of inconsistent, discrepant, and disconfirming information. Ignoring or discarding this type of vital information will lead to inaccurate assumptions, guesses, and probabilities rather than factual realities that could result in a series of decisional errors, which ultimately may be catastrophic. This result is supported by Durso et al.'s (1998) study of air traffic controller operational errors and situational awareness. Findings showed that "aware" controllers made significantly more thinking mistakes (i.e., poor judgment, reasoning, erroneous assumptions) than attentional, perception, or memory mistakes. In other words, even in a mindful state, if individuals reason from a nonpositive perspective, it leads to mindlessness and results in error.

The results of this study further showed that the most problematic effect was that precognitive commitment functioned as a two-headed dragon in inhibiting the formation of shared mindfulness in interactions. Interactants who engaged in precognitive commitment generally used a nonpositive reasoning strategy (negative, nonfact based, questioning) and were not able to perceive multiple perspectives. As a result, they tried to fit all the available data into one salient category (i.e., the availability of emergency services) and discarded any information that did not fit in that category. Therefore, participants were operating from the dangerous perspective of thinking they knew more than they actually did. The result was that they did not have an accurate perception of the current state.

Communication behaviors were identified in the findings as having a facilitatory effect in precluding interactants from engaging in precognitive commitment; in particular, using conditional language and verbalizing one's thoughts. First, presenting thoughts, opinions, and viewpoints in conditional language, especially in the captain's role, created an environment in which both participants were able to share information freely and nondefensively, which also tempered exhibiting overt dominance behaviors. In addition, it allowed the partner to disagree or bring into the discussion information that refuted or contested the reasoning of the other partner. Consequently, if one partner was reasoning from a negative perspective, when information was presented conditionally, the other partner could identify the fallacy in the reasoning in a nondefensive, nonthreatening but assertive manner. This allowed the other party to "save face" because his or her viewpoint was positioned conditionally such as: "The thunderstorms *might* be moving faster and cause a delay," or "we *could* land at the major airport *if* the headwind component isn't a significant factor." The outcome was that more discrepant and disconfirming information was brought into the discussion so that interactants were making a decision based on an accurate perception of the current state.

Finally, verbalizing one's thought processes precisely and in concrete terms allowed the partner to "see" or experience the other interactant's thought processes in real time. This base knowledge of where the other person was cognitively coming from assisted the dyad in creating shared meaning and mutual understanding quickly. Moreover, two processes stimulated two essential functions that prohibited precognitive commitment. Thinking aloud acted as a mechanism to stimulate an awareness of discrepant or disconfirming information and also prompted the

dyad to verbally reconstruct the task procedures per the contingencies of the crisis situation. The ability to reconstruct the task environment was critical in demonstrating to the dyad whether they had chosen the most effective decision option.

Impact of shared mindfulness to cultural diversity. With increasing globalization and the rise of company takeovers and mergers in the aviation industry, more and more cockpit crews represent diverse cultures. The results of this study may also prove beneficial from an intercultural CRM level. Several of the communication behaviors identified in this study as facilitatory to creating shared mindfulness are culture-inclusive of high-power-distance and collectivistic cultures. For instance, using conditional language is nonthreatening to a high-power-distance hierarchical structure. Perceiving multiple perspectives is germane to collectivistic cultures, which emphasize interdependence and valuing the input of the group. A defined set of specific communication behaviors is supportive of high-uncertainty-avoidance cultures such as many Latin American countries. Concurrently, for low-uncertainty-avoidance cultures like the United States, the ability to work outside of the box in terms of making fluid adjustments due to situational demands is enhanced through the communication behaviors of shared mindfulness because they facilitate an accurate perception of the current state.

Limitations

Because of this study's exploratory nature, more research is needed to corroborate the findings in terms of identifying the communication behaviors of shared mindfulness in diverse contexts outside of aviation. Therefore, because the typology was developed on the basis of one aviation context-bound study, caution should be exercised in generalizing from the present study to other settings. In the future, this study could be extended to other aviation and nonaviation high-risk contexts to explore the influence of varying research sites and different participants and scenarios. In addition, study interactants were senior-level aviation students, not experienced pilots who represent the majority of cockpit crews currently flying our world's airspace. Although they had a base knowledge of aviation, they lacked the full repertoire of behaviors, knowledge, and experience of the general pilot population. Consequently, communication behaviors conspicuously absent in the study interactions such as substantive acknowledgment may not represent the level of these communication behaviors present in the general pilot population. Future research should investigate the experienced pilot population to determine the generalizability of the communication behavior findings across both the inexperienced and experienced pilot populations.

Although attempts were made to simulate the aviation crisis environment, participants were not interacting in the actual (simulated cockpit) environment, which may have affected their ability to respond cognitively and physiologically to the crisis as they would if they had been in more realistic crisis conditions. Additional

research in the simulated environment could more closely duplicate the aircrew's physical environment and determine any cognitive and/or physiological mitigating effects on interactants. Finally, the current study centered on the interactants' conjoint state of mindfulness. Although data were collected via the Personal Outlook Scale, developed by Langer and her colleagues (personal communication, November 4, 2002), that measures the individual's propensity to mindfulness or a disposition of mindfulness, analysis of the data was beyond the scope of the current study. Future research could explore whether those interactants in dyads who exhibited high levels of the communication behaviors of shared mindfulness (e.g., findings indicated they also made the most effective decisions) or state of mindfulness also exhibit the trait or disposition of mindfulness.

In sum, this study sought to determine whether shared mindfulness exists in an interaction and to identify the communication behaviors of that psychological construct. The findings indicate that seven process categories of communication behaviors are associated with the construction of shared mindfulness in an interaction. Through examining these communication behaviors in an applied setting, we can enhance our understanding of how salient psychological constructs such as shared mindfulness are communicatively enacted in the environment. As a result, we advance theory building and simultaneously put shoes on the theory in the form of specific enactment behaviors in the environment.

APPENDIX A

Typology of Shared Mindfulness Communication Behaviors

<i>Process Category</i>	<i>Definition</i>	<i>Communication Behaviors</i>
Seeks information	Interactants seek information in the interaction via seeking their partner's input or opinion, clarifying or confirming their partner's communication including correcting erroneous information. Interactants notice new and/or missing information as well as identify information that contests or casts doubt on the available data.	Seeks input or opinion of partner Seeks clarification or confirmation of information from partner Verbalizes correct information when partner gives erroneous information or misspeaks Identifies/verbalizes new or missing (discrepant) information (i.e., it doesn't give our directional flight anywhere) Identifies/verbalizes information that contests or casts doubt (disconfirming) on the preferred decision option

Reasons from a positive perspective	Demonstrates reasoning that focuses on what is available and feasible while noticing and incorporating discrepant and/or disconfirming information and comparing those data against the proposed option(s).	Presents thoughts, ideas, input, and opinion from a perspective of what is available and possible Notifies and accepts discrepant and disconfirming information Compares and contrasts data
Perceives multiple perspectives	Interactants demonstrate the ability to perceive multiple information inputs, conditions, alternatives, and people perspectives. In so doing, they remain open to novelty actively processing the current state yet can sustain attentional focus to the task.	Able to view the situation, condition, data from an other orientation (e.g., crew member, customer) Awareness of environmental stimuli Seeks and incorporates multiple data inputs Perceives options/alternative courses of action
Projects thoughts and feelings	Interactants verbally and nonverbally project their thoughts and feelings in an interaction to engender accurate, real-time, mutual understanding.	Interactants speak their thoughts out loud, using precise, concrete terms, allowing the other person to see and/or experience their thought processes in real time as opposed to only verbalizing the result of their thought process (i.e., verbally walk through the individual steps of a procedure or reconstructing a task; identifies missing data, discrepancies, and disconfirming information) Uses diagrams, figures, or body movements to accurately translate verbal message by a pictorial representation of the information presented in a crisis scenario (i.e., demonstrating with hand gesture angle of plane landing on airfield) Uses nonverbal projection, including puzzling looks, furrowed brow, scratching head, etc.
Mindfully acknowledges partner communication	Interactants acknowledge each other's communication and demonstrate via a substantive response that the message has been received and critically processed.	Simple acknowledgment—demonstrates active listening by acknowledging partner statements via meta-communication (e.g., yes, uh-huh, right) Substantive acknowledgment—a verbal response that indicates the information was received and critically processed

Uses participative language	Interactants use language that emphasizes the tentative, conditional nature of information and the environment and demonstrate, through the use of inclusive terminology, joint ownership in the decision-making process.	Verbalizes thoughts, reasons, suggestions, and information using conditional terminology, thus engendering a discussion environment that allows for differing views and opinions along with the awareness of the contingent and ever-changing nature of environmental conditions (i.e., if we go for the major airport, we might not be able to make it) Uses "We" language over "I or You" language (e.g., we decided)
Demonstrates fluid turn taking	A ping-pong pattern of communication that facilitates achieving maximum participation by both interactants.	Demonstrates a ping-pong pattern of participation in which both partners add, clarify, confirm, or seek information in the discussion and build on and/or extrapolate beyond the information of the other Finish each other's sentences or complete a partner's thought so that their pattern of thinking demonstrates congruence

APPENDIX B

Glossary of Mindfulness Inhibitors

Precognitive commitment—Deciding on a sole course of action very early in the deliberative process with little or no discussion with the partner. This behavior involves viewing the situation through a familiar category and finding one salient element, then centering all reasoning on that element.

Quick-decision over right-decision mentality—Giving highest decision-making priority to the *time* factor such that the main focus is on a quick solution. This mentality fosters a tendency to precognitive commitment in which one salient element is chosen as the sole focus in the deliberative process, whereas other important data either go unnoticed or are discarded without being critically processed.

Overt dominance—Engaging in behaviors such as talk-overs; interrupting; not allowing for turn taking; lack of openness to the viewpoints, suggestions, and input of the other interactant, including nonverbal behaviors such as invading the other person's personal space.

Nonpositive reasoning strategies—Reasoning and supporting a position from a perspective that does *not* focus on what is available and feasible, nor aptly notice and

incorporate discrepant and/or disconfirming information. Thus, one does not make comparisons of proposed options or compares alternatives without incorporating all the available information.

Negative reasoning—Reasoning and supporting one’s position by focusing on what is lacking and potentially not possible or feasible in the less preferred option while contrasting and weighing alternatives against only the positive aspects of the preferred option. In reasoning from a negative perspective, one is less apt to notice discrepancy, disconfirming information, or alternative possibilities for action.

Nonfact based—Reasoning centered on focusing and evaluating data from an emotional perspective such that the individual is inflexible when presented with logical facts that support an opposing view or position and will not accept or process discrepant and/or disconfirming information.

Question based—Primarily reasoning by posing questions as input or seeking input via broad nonspecific questions such as “Do you see anything wrong with that?” In employing question-based reasoning, interactants acted as passive rather than active problem solvers.

APPENDIX C

Study Scenarios, Decision Options, and Decision Criteria

SCENARIO 1

Roles: Captain and First Officer

You are the captain and first officer of a corporate jet just about to taxi for Runway 26 at the airport used by your company. There will be no delay on your departure if you taxi by 2:00 p.m., because it is a 10-minute taxi, and at 2:10 p.m., the airport will be closed for 2 hours because Air Force 1 is due to arrive with the president on board. You have also been made acutely aware, by the company owner who is sitting in back in the passenger cabin, that an on-time departure is crucial to winning a huge new contract that may save the company from bankruptcy.

You notice a thunderstorm about 2 to 3 miles off the upwind end of the runway, that is, 2 to 3 miles from the threshold of runway 08. You could possibly execute a tailwind take-off on 08, but the wind is reported as 260/05, and you have a maximum permissible tailwind component of 10 kts. You are also very aware that to get to runway 08 would require a long and time-consuming taxi, up to 20 minutes, so if you are going to do, this you will need to taxi even sooner.

The time is now 1:45 p.m.

Decision Options

1. Take off on runway 26 and avoid the thunderstorm.
2. Allowing for the fact that participants have limited aviation experience—in particular, with thunderstorm hazards—they will probably choose the 08 takeoff. The wind is within limits.
3. Delay the takeoff.

Decision Effectiveness Criteria

Decision 1 = effective: Gets the airplane off on time without having to rush, and it should be no problem.

Decision 2 = less effective: Taking off downwind is fine, but if the storm (now behind them) produces a microburst, then the tailwind would become excessive, and they would likely run off the end of the runway.

Decision 3 = ineffective: Although it is nice and safe, they would not have achieved maximum effectiveness; that is, their boss's deal would fall through! It is possible to get an effective result by going for Decision 1, and safety still is not compromised.

SCENARIO 2

Roles: Captain and First Officer

You are cruising at 31,000 ft when all engines stop. The captain attempts to relight them without success and set up an all-engines-failed range descent.

Your position is 30 miles from a small civilian airfield used mainly for gliding, which has a cloud base at 3,000 ft. The airfield is familiar to the first officer. The nearest major airfield with full emergency facilities is on the extreme limit of your gliding range, and you would have a headwind component to reach there.

The first officer is inexperienced on type but has gliding experience. However, you also recognize that the nearest major airfield has full emergency services, but you are not convinced the aircraft could reach the major civilian airfield.

In just 5 minutes, the major airfield will be out of gliding range.

Decision Options

1. Put the airplane on the ground at the nearest suitable airport (small civilian airfield 30 miles away).
2. Attempt to make it to the major airfield.

Decision Effectiveness Criteria

Decision 1 = effective: The safest option is to find somewhere well within gliding range and put the aircraft on the ground. If the small airfield is suitable for landing, then it should be used regardless of whether or not it has full facilities.

Decision 2 = ineffective: An attempt to make the major field is likely for all the wrong motives—the desire for full facilities. This is a risk assessment problem—weighing the risks of landing at an airfield without full emergency facilities versus the risk of trying to stretch a glide and make it to one that does. The *first risk* is that if the landing does not go well, then there may be a few injuries that will require treatment. The *second risk* is that the airplane may not make it due to an unseen headwind, in which case the airplane will land and crash somewhere else, resulting in likely death and serious injury among countless individuals (on the ground as well as in the airplane).

NOTE

1. Crew resource management (CRM) is the concept of maximizing mission effectiveness and safety through effective utilization of all available resources. CRM is applied to the process of training aviation crews in such concepts as interpersonal skills, team building, briefing strategies, stress management, decision-making strategies, situational awareness, and organizational culture.

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