SAY IT AGAIN, SAM!
EFFECTIVE COMMUNICATION STRATEGIES TO MITIGATE PILOT ERROR

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ABSTRACT

Study 1 investigated role and status effects on communication strategies, using responses to written problem scenarios. Responses were assigned to eight classes of communications differing in terms of request perspective, explicitness and directness. Analyses revealed that captains predominantly used commands while first officers preferred hints, i.e. problem and goal statements. Study 2 examined the effectiveness of the eight communication types, using pilots' effectiveness ratings. Both crew positions rated crew obligation statements as more effective than commands. Overall, effective communication strategies were those that made clear what to do while appealing to the crew's shared responsibility for coping with problem situations.

INTRODUCTION

The essential thrust of Crew Resource Management (CRM) is to promote team work among pilots and thus to reduce human error. In addition to performing their individual tasks, crew members are expected to support each other by monitoring the situation as well as each other's performance and to intervene if a problem is detected. However, failures to do so are not infrequent. The National Transportation Safety Board reviewed all flightcrew-involved major accidents of US air carriers between 1978 and 1990 and identified monitoring or challenging errors in 75% of these 37 accidents (NTSB, 1994). Similarly, Jentsch et al. (1997) analyzed ASRS reports on junior first officer errors and found that 54% of the cases concerned monitoring/challenging or assertiveness.

Pilots may fail in this critical crew function either because they did not notice a problem, or because they did not succeed in communicating their concerns to the other pilot. Our work addresses the second issue. Study 1 examined pilots' communication strategies to correct an error or problem on the flight deck. Study 2 investigated how first officers and captains could do so effectively.

STUDY 1

This study was conducted to determine which communication strategies pilots claim they would use to mitigate errors by another crew member. Based on previous research (Linde, 1988; Orasanu & Fischer, 1992) we hypothesized that pilots' communications would be influenced by three variables: (1) the status of the speaker relative to the status of the addressee; (2) the risk inherent in the situation; and (3) the degree of "face-threat" involved in challenging an error. Previous analyses of crew discourse during simulated flight found that captains were more direct in addressing first officers than first officers were in addressing captains (Linde, 1988; Orasanu & Fischer, 1992). However, for both crew positions communications were more direct during problem and emergency situations than during normal flight segments. In addition to risk we suspected that pilots' communications would be sensitive to the degree to which an error implied a threat to the professional "face" of a crew member. If others have made an obvious error, calling it to their attention may involve a direct challenge to their status, judgment or skill. According to politeness theory (Brown & Levinson, 1987), in situations like these speakers will seek to protect their addressee's face and use more indirect speech as compared to situations that are less face-threatening.

METHOD

157 pilots (69 captains and 88 first officers) from three major US airlines participated in the study. All participants were male.

Participants received eight short descriptions of aviation incidents which varied in their threat to flight safety (high or low risk) and type of problem (high or low face-threat errors). Minor errors, such as an oversight, were considered to be low in face-threat because they did not involve a direct challenge to the pilot's skill or judgment. Major errors, such as an altitude bust, were considered to be high in face-threat because correcting them necessitated a direct challenge to the pilot's skill. For participating

captains, low- and high-risk incidents were described from the perspective of the captain and involved errors or oversights on the part of the first officer, the pilot-flying. For first officer participants, the incidents were identical except that they described captains making errors and oversights.

Participants read the incident descriptions and were asked to imagine themselves in the position of the non-flying pilot (captain or first officer - depending on the crew position of the participant). Each incident description was followed by a goal statement. The participants' task was to write out verbatim what they would say to the pilot flying (the first officer or the captain) in order to achieve the stated goal. For instance, captain participants saw the following description and goal statement:

> While cruising in IMC at FL 310, you notice on the weather radar an area of heavy precipitation 25 miles ahead. First Officer Henry Jones, who is flying the aircraft, is maintaining his present course at Mach .73 even though embedded thunderstorms have been reported in your area and you encounter moderate turbulence.
>
> *You want to ensure that your aircraft will not penetrate this area.*

Following the coding scheme of Blum-Kulka, House, and Kasper (1989) responses were assigned to eight classes of communication that differed in terms of their focus, explicitness and directness. Other-directed communications or requests referred to an action the addressee was to perform, while speaker-centered communications specified an action by the speaker. Both types of communications could vary in the extent to which speakers were direct and explicit about what action to take and who is to do it. Overall six classes of other-directed communications, and two classes of speaker-centered communications were distinguished, as shown in Table 1.

Responses were also coded in terms of their structure, either simple or complex. Simple communications involved only a request or a speaker-centered communication. Complex communications consisted of two parts: one that realized the stated goal and a second one that provided reasons for the request or speaker-centered communication. An example of a complex communication is *"I see we have some cells painting on radar. I think we should turn left about 30°."*
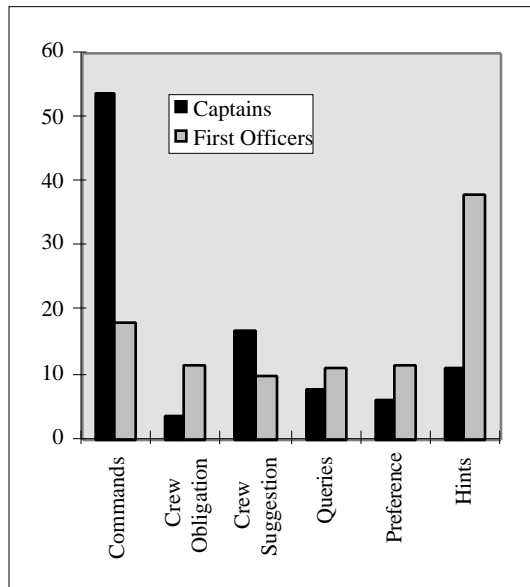
Table 1. Classes Of Communications

REQUESTS (= OTHER-DIRECTED COMMUNICATIONS)	
Commands	*Turn 30° right.*
Crew Obligation Statements	*I think we need to deviate right about now.*
Crew Suggestions	*Let's go around the weather.*
Queries	*Which direction would you like to deviate?*
Preferences	*I think it would be wise to turn left or right.*
Hints	*That return at 25 miles looks mean.*
SPEAKER-CENTERED COMMUNICATIONS	
Self-Directives	*I am going to get a clearance to deviate around these storms.*
Permission-seeking Questions	*You want me to ask for clearance to deviate around this weather?*

RESULTS AND DISCUSSION

Analyses of the responses revealed that first officers most often used hints to get action from the captain. That is, first officers preferred statements such as *"That return at 25 miles looks mean"* that did not specify any corrective action, but instead pointed to a problem or reminded the captain of a previously established goal. Apparently first officers assumed that the captain would feel committed to a corrective action once he agreed with their assessment of the situation. In so doing, first officers at most questioned the captain's understanding of the situation. But they minimally challenged his status since the decision about how best to respond to the problem was left to the captain. Captains, in contrast, predominantly used commands to correct first officers. This pattern of findings indicates that while pursuing identical communicative goals, captains take a more direct route than first officers. As expected, captains were more likely than first officers to specify the action that should be taken. Moreover, in issuing more commands and fewer hints than first officers, captains expressed their intentions more forcefully than first officers; i.e., there was a stronger obligation for first officers to comply with captains' requests than vice versa.

Figure 1.
Distribution Of Captains' And First Officers'
Request Strategies (In Percentage Of All Other-
Directed Communications)

Similar status differences were observed for communications that concerned actions by the speaker. First officers were likely to assure that the captain agreed with their planned action as in *"Do you want me to ask ATC if they still want us on this heading?"* 57% of all first officers' speaker-centered communications were of this kind. Captains, on the other hand, almost never used permission-requests relying instead on self-directives (91% of the time) such as *"I'll call ATC and find out if he still wants us on this heading."*

While both captains and first officers became more direct when risk increased, status differences nonetheless persisted. Captains adjusted to higher risk levels mainly by issuing even more commands than in low-risk situations (from 47% to 63%). First officers, in contrast, quadrupled their use of crew obligation statements (from 4% to 16%) as risk increased. However, hints remained their predominant strategy, even in high risk situations. Captains' and first officers' request strategies not only varied with risk but also changed with error type. Though commands were captains' preferred response to both low face-threat and high face-threat errors, captains tended to use more hints in situations in which first officers committed some major error, e.g., an altitude bust, rather than some minor oversight. First officers were likely to increase commands, crew obligation statements and suggestions in these situations while hints remained their dominant strategy.

Concerning the structure of pilots' communications we found that for both crew positions, more direct requests were usually accompanied by justifications as in the following example: *"We are too far left of centerline for parallel approaches - correct right immediately!"* On average, 63% of captains' and first officers' direct requests (i.e., commands, crew obligation statements and suggestions) were of this kind. As the example illustrates, justifications may serve several social and cognitive purposes. By referring to some problem or goal in addition to making a direct request, speakers decrease the imposition of their communication on the addressee. Since there is some objective event requiring an action, the speaker's request becomes reasonable and his role in requesting is thus minimized. In addition, speakers who mention a problem and action make their thinking transparent and may thus facilitate a crew's shared understanding of the situation. Interestingly, we also observed that captains and first officers generally supported speaker-centered communications with problem or goal statements. This finding may indicate two points: First it may suggest that speaker-centered communications are considered to be rather bold communicative moves that require some mitigation. Recall that the speaker in all scenarios is the pilot-non-flying. Or, it may imply that the speaker seeks to coordinate the activities of the crew and in order to do so, provides the broader context.

Before leaving the discussion of differences between captains' and first officers' communication strategies we want to stress that our analyses concern pilots' initial reactions to errors or oversights of the pilot flying. Study 1 neither allows conclusions on how effective captains' and first officers' communications actually would be in getting another crew member to comply with their intended action. Nor does Study 1 allow inferences on how captains and first officers would proceed if their initial attempt to mitigate a pilot error should fail. Study 2 was conducted to follow up on the first issue. In this study we examined whether the communications captains' and first officers' indicated they would use for error mitigation are considered to be effective strategies, or whether captains and first officers could be more effective if they relied upon different strategies.

STUDY 2

This study had several objectives. We wanted to determine which of the communication strategies discerned in Study 1 would be effective in mitigating pilot error, and whether supporting statements would enhance the effectiveness of strategies. Moreover, we

wanted to see whether the perceived effectiveness of strategies varied for captains and first officers, as well as with the risk level and degree of face-threat inherent in an incident.

63 pilots (31 captains and 32 first officers) from a major US airline participated in this study. Participants received the eight incident descriptions as well as instances of the different communication strategies that we could distinguish in Study 1. Per incident we listed one example of each of the request strategies and speaker-centered communications listed in Table 1. Participants were asked to imagine that they had just committed the mistake described in the scenario and that the communications were directed at them. Their task was then to rate on a 9-point scale how effective each communication would be in getting them to carry out the speaker's intent. Communications they judged to be most effective were to receive a rating of "9." These were defined as "highly appropriate to the problem while maintaining a positive crew climate." Least effective communications were to receive a rating of "1" and were defined as "tactless, excessive or inappropriate." In a second task, participants were asked to rate how direct each communication type was; i.e., "how clear it was what the speaker wanted done and how much pressure he put on the addressee to act." The order of effectiveness and directness ratings were counterbalanced across participants.
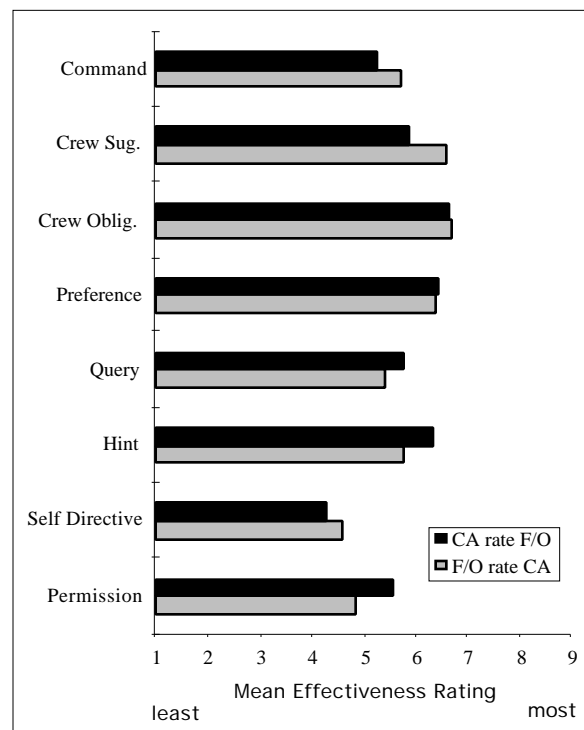
Participating captains were told that the communications were from first officers. First officer participants received the same communications, and were told that these were captains' communications. Half of the participants in each pilot group received simple communications; i.e., the communications consisted only of a request or a speaker-centered communication. The remaining participants received complex communications; i.e., they were asked to rate requests and speaker-centered communications that were supported by problem or goal statements.

RESULTS

Analyses of captains' and first officers' mean ratings of the communication types per scenario revealed the following statistically significant effects: (1) Communications that were supported by a problem or goal statement received higher effectiveness ratings (Mean = 5.8) than unsupported communications (Mean 5.5). Complex and simple communications, however, were perceived as equally direct (Mean = 5.8). That is , both constructions were comparable in the extent to which they specified a corrective action and enforced compliance. (2) As shown in Figure 2, the most effective strategies for both crew positions were neither too direct (i.e.,

commands) nor too indirect (i.e., permission requests). Captains judged first officers' crew obligation statements, preference statements and hints to be significantly more effective than their commands, self-directives and permission requests. First officers thought that captains were significantly more effective when they used crew obligation statements rather than commands, queries, hints, self-directives and permission requests.

Figure 2.
Captains' And First Officers' Mean Effectiveness Ratings Of Different Types Of Other-Directed And Speaker-Centered Communications (Aligned from Most to Least Direct)

(3) The judged effectiveness of communication strategies varied with the level of risk inherent in a situation. In high-risk as compared to low-risk situations, the effectiveness rating of more direct communication strategies increased, while it decreased for less direct strategies. However, even in high-risk situations crew obligation statements were rated as more effective than commands. (4) Face threat inherent in an incident also played a role in pilots' effectiveness ratings. In particular, hints were judged to be more effective when used to correct highly embarrassing mistakes rather than minor errors. In high face-threat situations pilots rated this strategy to be as effective as crew obligation and preference statements, and considered it to be more effective than all the remaining strategies.

With the exception of commands, captains' judgments corresponded reasonably well to the frequencies with which first officers in Study 1 used the various request strategies. Overall, a medium strong rank order correlation between captains' effectiveness ratings and observed frequency of first officers' strategies was observed (rho = .46). That is, hints, crew obligation and preference statements were both produced frequently by first officers and were judged by captains to be very effective. In contrast, first officers' effectiveness ratings of captains' strategies did not correlate as strongly with captains' strategy use in Study 1 (rho = .30). The low correlation coefficient indicates a mismatch between first officers' opinions about effective captain strategies and captains' actual responses. Crew obligation statements, crew suggestions and preference statements, the top three captain strategies according to first officers, were rarely used by captains (4%, 17% and 6% of all captain requests, respectively). On the other hand, commands - captains' dominant request strategy - received a considerably lower effectiveness rating.

CONCLUSIONS

Together, studies 1 and 2 suggest that the strategies pilots indicated they would use to mitigate pilot errors, may not be the most effective ones. While we obtained striking differences in captains' and first officers' communication strategies, there was considerable agreement between captains and first officers on what constitutes effective communication. Both pilot groups gave high effectiveness ratings to crew obligation statements, preference statements, crew suggestions and hints, and consistently rated commands, the most direct communication strategy, as less effective. The common element of these strategies is that they address a problem without disrupting the team context. Crew obligation statements, crew suggestions, and preference statements are like commands insofar as they explicitly state what should be done. But unlike commands they do not rely on status differences to assure compliance. Crew obligation statements seek compliance by appeal to a shared obligation. Crew suggestions and to some extent preference statements do so by referring to the solidarity between speaker and addressee. Hints are similar to crew obligation statements insofar as they too seek compliance by appeal to an external necessity. Many of the hints that first officers produced in Study 1 are problem or goal statements that strongly imply what action should be taken as for example "*Clearance was to 9000!*" or "*I show you 15 kts slow.*" That is, once the addressee acknowledges the problem, he is also committed to the appropriate action.

Effective communication strategies thus appeal to a crew's shared responsibility for coping with problem situations. This characteristic is again reflected in pilots' judgments of complex communications. Requests and speaker-centered communications that were supported by problem or goal statements were rated as more effective than communications without supporting statements. The advantage of complex communications is that they may facilitate the crew's shared understanding of problem situations and their joint problem solving (Orasanu, 1994). Speakers who mention a problem in addition to requesting an action or stating their intention to act ensure that other crew members are able to see why a particular corrective action ought to be taken. Moreover, crew members are then in a position to verify for themselves that the speaker's problem understanding is appropriate, and that the intended action is indeed the best response.

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