CULTURAL VARIABILITY IN CREW DISCOURSE

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ABSTRACT

Four studies were conducted to determine features of effective crew communication in response to errors during flight. Study One examined whether US captains and first officers use different communication strategies to correct errors and problems on the flight deck, and whether their communications are affected by the two situation variables, level of risk and degree of face-threat involved in challenging an error. Study Two was the cross-cultural extension of Study One and involved pilots from three European countries. Study Three compared communication strategies of female and male air carrier pilots who were matched in terms of years and type of aircraft experience. The final study assessed the effectiveness of the communication strategies observed in the previous three studies.

CULTURAL VARIABILITY IN CREW DISCOURSE

The essential thrust of Crew Resource Management (CRM) is to promote teamwork among pilots and thus to reduce human error. In addition to performing their individual tasks, crewmembers 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. Specifically, the present research was designed in an effort to guide crew training by identifying effective communication strategies pilots could use to mitigate errors or problems on the flight deck.

What does effective communication entail in this context? One may be inclined to postulate that crew members ought to be very assertive in their intervention; i.e., they should be explicit about what needs to be done and they should explicitly direct the other crew member to take the corrective action (see e.g., Greenberg, 1999). The demand for explicit and direct communication, however, underestimates the important role that social considerations play in interactions. As Watzlavick, Beavin and Jackson (1967) have pointed out, every utterance has two components: the referential which makes some predication about the world, and the relational, by which we signal something about our social relationship to the listener. Communication is not just a matter of what we say; it is also how we say it that determines the received message. Moreover, whether or not we are successful in our communications depends critically on the extent to which we can accommodate both the referential and the relational component. This is particularly true

in situations in which we place demands at our listeners, for instance when we want them to change their behavior. In these situations we want our listeners not only to understand our intentions but we also want them to act accordingly (Searle, 1969). How speakers can best assure listener cooperation varies with their relationship (Herrmann & Grabowski, 1994). Superiors, by virtue of their social status, may be licensed to give direct commands to their subordinates. If subordinates reverted to the same linguistic strategy, superiors may perceive them as threatening and may refuse compliance. To avoid this kind of confrontation, subordinates are likely to use more polite and as such more indirect ways of communicating (Brown & Levinson, 1987). However, by being indirect subordinates run the risk of being misunderstood or of not being heard (Linde, 1988).

There is thus a tension between informative communication and socially successful ways of communicating. We suggest that effective communication seeks to optimize informativeness and social appropriateness. How this can be achieved in crew discourse may vary as a function of five variables: (1) the status of the speaker relative to the status of the addressee; (2) the risk inherent in the situation; (3) the degree of "face-threat" involved in challenging an error; (4) culture-specific norms for interacting with superiors and subordinates; and (5) the gender of the speaker.

Previous analyses of crew discourse (Linde, 1988; Orasanu & Fischer, 1992) found that captains were more direct in addressing first officers than first officers were in addressing captains. 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 crewmember. 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. Moreover, norms that define polite and socially appropriate behavior vary across cultures and were found to foster distinct conversational styles (Gudykunst, W. B., Ting-Toomey, S., & Chua, E., 1988; Hall, 1976; Holtgraves, T., & Yang, J-N. 1992) and attitudes toward leadership (Merritt & Helmreich, 1996; Redding & Ogilvie, 1984). These findings suggest that pilots from different cultures may also favor distinct communication strategies. An issue related to cross-cultural differences in communication style concerns gender differences. In recent years sociolinguists have advanced the position that women talk differently than men (e.g., Tannen, 1990). Men were found to be more explicit, directive and task-oriented than women. Female speech, in turn, has been characterized as indirect and concerned with relational aspects of interactions (Lakoff, 1975; Tannen, 1990, 1994a). The present research sought to determine whether similar differences characterize communications of male and female pilots.

Four studies were conducted. Study One involved male US air carrier pilots and addressed the effect of status, risk level and degree of face-threat on their communication strategies. Study Two was the cross-cultural extension of Study One and compared US pilots with those from three European countries. Study Three examined the effect of gender on crew discourse. Male and female air carrier pilots from the US who were matched in terms of years and type of aircraft experience, participated in a task similar to Study One. The final study assessed the effectiveness of the communication strategies observed in the previous studies.

STUDY ONE

The aim of this study was to determine which communication strategies captains and first officers would use to mitigate errors by another crewmember. The effects of two situation variables were also examined: (a) level of risk inherent in a situation and (b) the degree of "face-threat" involved in challenging an error. 157 pilots (69 captains and 88

first officers) from three major US airlines participated. All participants were male. The captains had on average 9.5 years in this position and had an average of 23.1 years of experience in Part 121. For first officers, position-specific experience was on average 5.6 years, and experience in Part 121 was 10.2 years.

Eight short vignettes were constructed that described aviation incidents. Vignettes were modeled after incidents reports that had been submitted to the Aviation Safety Reporting System. Four of the incidents described minor errors by the pilot flying while four involved major mistakes. 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 mistakes, such as an altitude bust, were considered to be high in face-threat because correcting them meant a direct challenge to the pilot's skill or judgment. For each incident we designed a low- and a high-risk version by varying elements such as terrain, weather, or phase of flight. Participants received either the low- or the high-risk version of an incident. 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, incidents were identical except that they described captains making errors and oversights. Vignettes were printed in a test booklet, one description per page. Random orders of the vignettes were created yielding 16 differently ordered captain and first officer booklets.

Participants were asked to complete two tasks: a Discourse Completion Task and then a Judgment Task requiring participants to rate each incident in terms of risk to flight safety and how embarrassing it was to the other pilot. In the Discourse Completion Task, 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.*

There are many ways in which the non-flying pilot could achieve this goal. He

could either take some action himself or could ask the pilot-flying to take a particular

goal-consistent action. We categorized the former as speaker-centered communications

and the latter as other-centered communications or requests. An example of a speaker-

centered communication is, *"I am going to talk to ATC and request a deviation."*

Requesting a colleague to act, on the other hand, could be done by saying *"Let's go*

around the weather."

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. Following the coding

scheme of Blum-Kulka, House, and Kasper (1989) six classes of requests, i.e., other-

directed communications, and two classes of speaker-centered communications were

distinguished, as shown in Table 1.

TABLE 1. Classes Of Communication Strategies

	REQUESTS (= OTHER-DIRECTED COMMUNICATIONS)	
COMMUNICATION TYPE	EXAMPLE	DESCRIPTION
Commands	*Turn 30° right.* *Altitude!* *Watch your altitude!*	• Imperatives - intended action and agent explicit • SOP alerts - demanding attention - intended action implied
Crew Obligation Statements	*I think we need to deviate right about now.*	- specify obligation of the crew to perform some action - commit by external necessity - who is to act is implied
Crew Suggestions	*Let's go around the weather.*	- suggest some action of crew - who is to act is implied - commit by appeal to solidarity
Queries	*Which direction would you like to deviate?* *Are you planning to go around that weather?*	• Specifying Questions - ask for details on intended action, - compliance of hearer implied • Intention questions - ask for hearer's intention or willingness to perform action
Preferences	*They want you to level at 9,000.* *I think it would be wise to turn left or right.* *I would prefer to go around these storms*	• Relayed Requests - quote 3rd party instruction • Strategies - mention corrective action while leaving agent unspecified. • Preferences - speaker asserts preference for action, or what he would do
Hints	*That return at 25 miles looks mean.*	• Problem or Goal Statements - refer to some problem or remind of goal - action and agent implied
	SPEAKER-CENTERED COMMUNICATIONS	
Self-Directives	*I am going to get a clearance to deviate around these storms.* *I have the aircraft!*	• Statement of Intent - speakers asserts intention to perform some action • Self-initiated Action - speaker performs action without previously announcing intention
Permission-seeking Questions	*You want me to ask for clearance to deviate around this weather?*	- speaker asks hearer to license speaker action

Commands are the most direct form of request -- they leave little doubt about what action a speaker wants his addressee to perform. SOP alerts were subsumed under commands because they demand that the addressee attend to some violation and in so doing demand its correction. Crew obligation statements and crew suggestions are less direct than commands insofar as they do not explicitly refer to the addressee as the one who is to take the action. Moreover, crew suggestions are less forceful than either commands or crew obligation statements because they simply propose, rather than assert a particular corrective action. Commands and crew obligation statements, in contrast, are more binding, the former by demanding adherence and the latter by appealing to an existing obligation. Queries, the fourth request type neither call for nor assert a particular corrective action. Instead, speakers inquire about the addressee's willingness to take the action. Similarly, preference statements are indirect requests insofar as speakers do not overtly make a request but rather express their or a third party's (i.e., ATC) preference for a particular course of action. Hints, i.e., problem or goal statements, are the least direct form of request. Speakers do not specify any course of action; rather they point to a problem or remind of a previously established goal.

Similar distinctions were made for speaker-centered communications. Self-directives are the most direct form of speaker-centered communication. Like commands, they leave little doubt about the speaker's intentions and express a strong commitment on his part to a particular course of action. Permission-seeking questions, in contrast, leave it to the addressee to agree with a planned action of the speaker.

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 a reason 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°."*

To assess the reliability of the coding, 25% of the responses to each scenario were randomly selected and independently coded by two judges. Percent agreement between the raters was high: 90% for coding of the communication strategies and 88% for their structure.

I. DO CAPTAINS AND FIRST OFFICERS DIFFER IN THEIR PREFERRED STRATEGIES FOR CHALLENGING THE ACTIONS OF THE PILOT-FLYING?

First, we will describe requests or other-directed communications, and then we will turn to speaker-centered communications.

Requests. 78 percent of the captains' and 80 percent of the first officers' responses were requests for the other pilot to take action. Hierarchical log-linear analyses revealed that first officers and captains favored different request strategies. Most noticeable is their distinct use of hints and commands, the two most common strategies. Captains most frequently used commands[1], while 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.

While captains also used hints, they did so less frequently than first officers. As Figure 1 shows, hints were three times more frequent in first officers' than in captains' communications. Captains, on the other hand, used commands three times as often as

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[1] SOP alerts were fairly infrequent forms of commands for both crew positions. Overall, 1 percent of captains' and 2.4 percent of first officers' requests were alerts.

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.
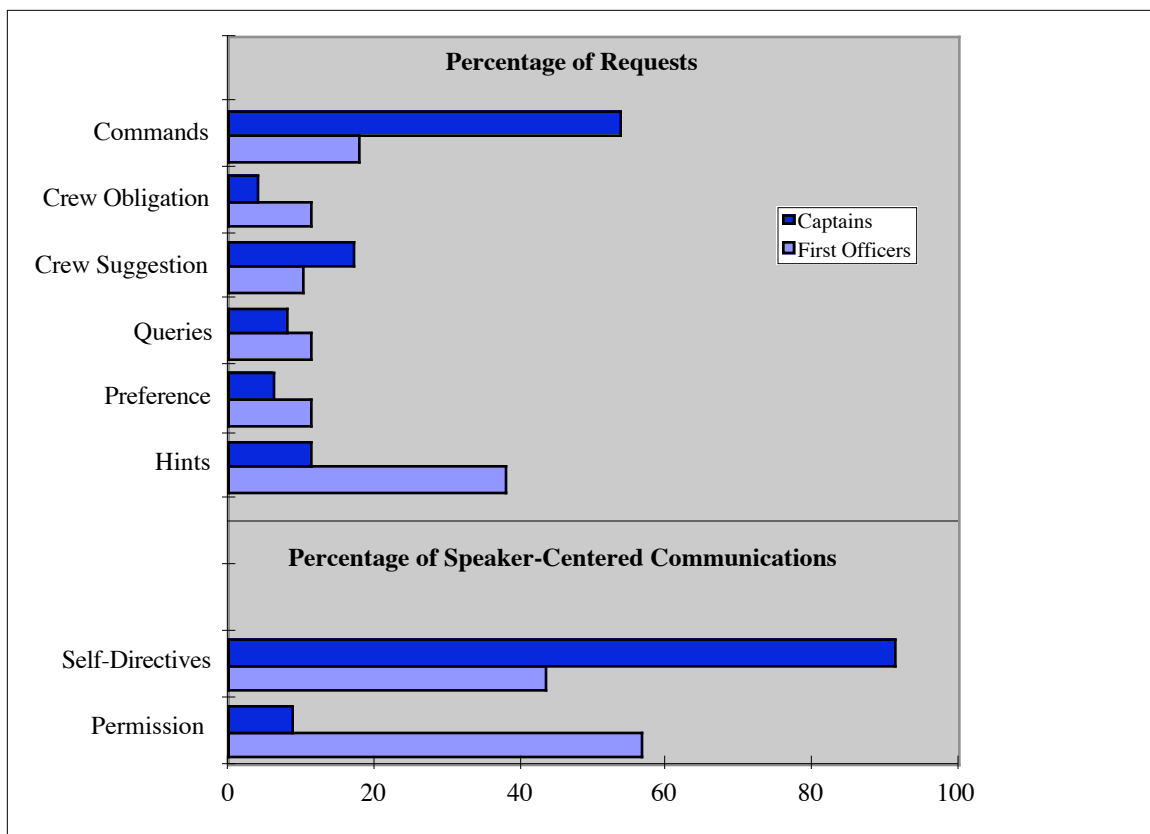
Figure 1. Captains' And First Officers' Communication Strategies.

However, direct requests, such as commands, were frequently 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 both 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 may decrease the imposition of their communication on the addressee. In addition, since they explain why a particular action is required, they may also facilitate a crew's shared understanding of the situation.

Speaker-centered communications. About 21 percent of all communications were speaker-centered rather than other-directed (i.e., requests). Status-based differences were again observed for speaker-centered communications. US captains almost never asked permission-seeking questions, relying instead on self-directive statements like, *I'll call ATC and find out if he still wants us on this heading.*" (91% of the time). US first officers, in contrast, preferred permission requests to self-directives. In 57 percent of their speaker-centered communications they verified that the captain agreed with their planned actions as in the following example: *"Do you want me to ask ATC if they still want us on this heading?"*

Since self-directives are more assertive than permission-seeking questions, we predicted structural differences between these utterance types similar to the ones observed for more and less direct requests. That is, we expected that speakers would feel more inclined to justify self-directives than permission-seeking questions. Contrary to our expectations, complex communications dominated both self-directives and permission-seeking questions by captains and first officers. This finding may either indicate that speaker-centered communications are in general considered to be rather bold communicative moves that require some mitigation. Recall that the speaker in all scenarios is the pilot-not-flying. Or, it may suggest 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 One 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 One allow inferences on how captains and first officers would proceed if their initial attempt to mitigate a pilot error should fail. We will take up the first issue in Study Four. 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.

II. HOW DO PERCEIVED THREAT TO FLIGHT SAFETY AND ERROR TYPE AFFECT PILOTS' CHOICE OF STRATEGY?

So far, we have addressed pilots' communication strategies in general, across situations, without considering how specific features of situations influenced strategy use. Two situation variables were manipulated in our study: level of risk inherent in a situation and degree of face-threat involved in challenging a pilot error. There were four types of scenarios: low-risk and high-risk situations involving either minor errors by the pilot-flying or highly embarrassing mistakes on his part. As their ratings in the Judgment Task revealed, 107 of the 157 participants did distinguish between these four types of scenarios. Their ratings of risk and face-threat were not significantly correlated; in contrast, the remaining 50 participants generally rated high-risk situations as more embarrassing than low-risk situations. Responses of these latter participants were consequently excluded from the analyses concerning the effects of risk and type of pilot error on communication strategies.

Figures 2 and 3 show that varying risk levels and degrees of face-threat significantly influenced how US captains and first officers phrased requests. Neither variable, however, had a significant effect on their speaker-centered communications.
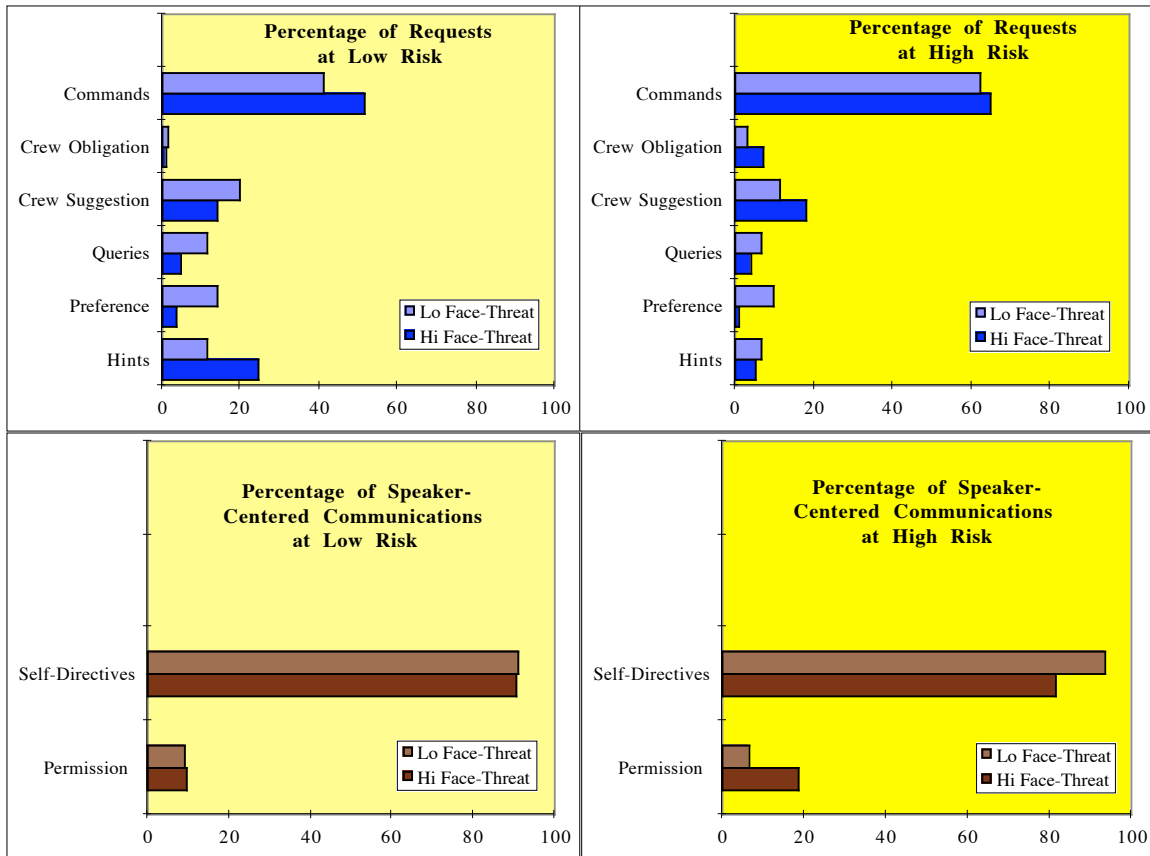
Figure 2. Captains' Communication Strategies As A Function Of Risk Level And Degree Of Face Threat.

As indicated by their ratings in the Judgment Task, US captains and first officers agreed in their risk assessment of the incidents (F(1,105) = 2.92, ns.). Moreover as predicted, both pilot groups were more direct with increased risk, albeit their strategies shifted in a status-consistent manner. Captains adjusted to higher risk levels mainly by using even more commands and even fewer hints than in low-risk situations. US first officers, in contrast, used considerably more crew obligation statements, but also more commands and crew suggestions. Overall, their use of these direct request strategies rose from 24% in low-risk events to 47% in high-risk incidents. However, hints remained their single most frequent request strategy, even in high-risk situations.
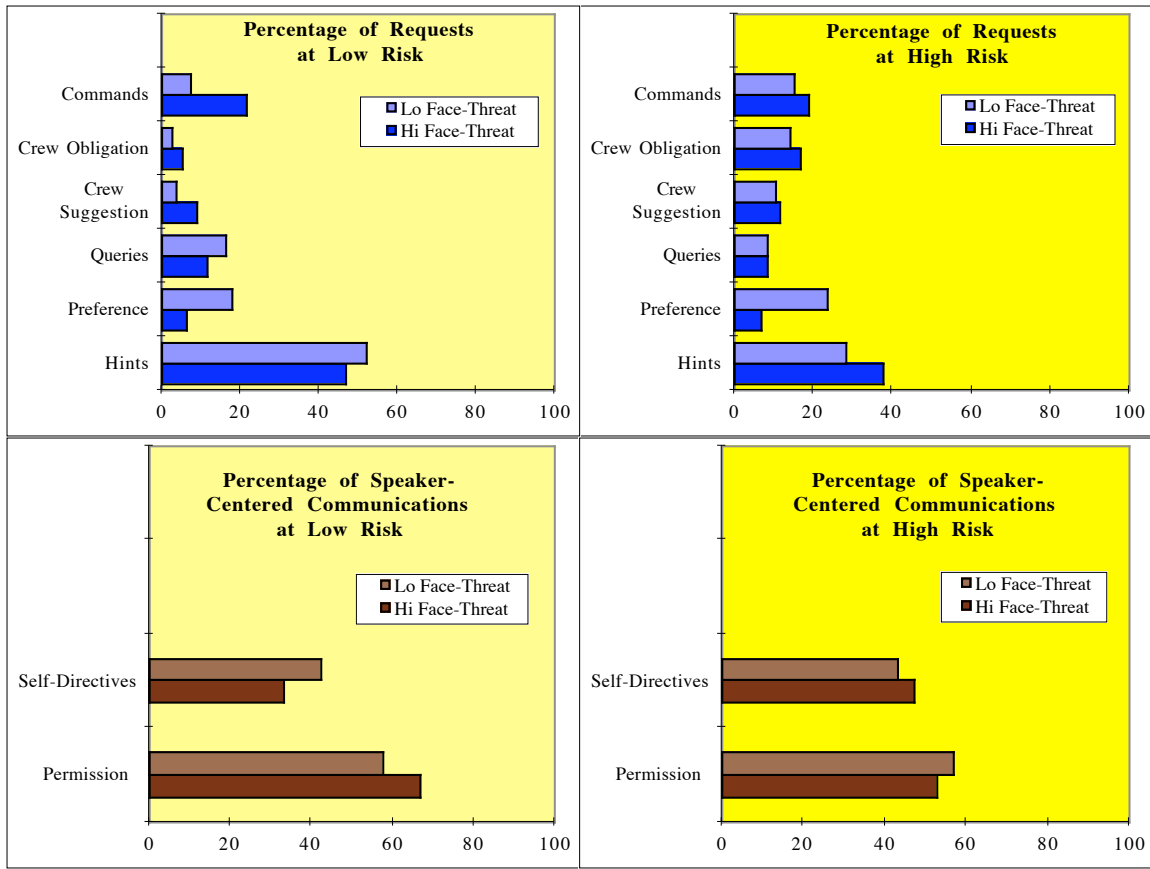
Figure 3. First Officers' Communication Strategies As A Function Of Risk Level And Degree Of Face Threat.

Both US captains and first officers rated major mistakes as more embarrassing for the pilot flying than minor errors (F(1,105) = 200.53, p < .000); however, captains considered high face-threat incidents as more embarrassing than first officers (M = 6.85; M = 5.55, respectively; F (1,105) = 20.44, p < .000). Moreover, pilots' responses to low and high face-threat errors were not consistent with the predictions made by politeness theory as they generally did not shift to more indirect request strategies when they had to correct highly embarrassing mistakes.

Captains showed a dual response to high face-threat errors of the first officer. They tended to use more hints but also more commands to correct major mistakes of the first officer as compared to situations in which their communications concerned some

minor oversight on the first officer's part. Overall, commands remained their preferred response to both types of first officer error. Captains apparently focused either on the extent to which their intervention would directly challenge the first officer's professional "face" thus preferring indirect requests for high face-threat errors, in particular when risk was low, or, especially in high-risk situations, they responded to the magnitude of the error correcting major mistakes more decisively than minor oversights.

First officers were likely to use more commands, crew obligation statements and crew suggestions in high face-threat as compared to low face-threat incidents. But hints was their dominant strategy to request action from the captain, irrespective of the type of captain error. This response pattern of first officers might reflect the joint effect of risk level and error type on their request strategies. Figure 3 suggests that in low-risk situations, first officers became more direct (i.e., used more commands and fewer hints) when their requests concerned major errors by the captain rather than minor oversights. In high-risk situations, their use of direct requests remained the same while the frequency of hints increased in response to high face-threat errors. That is, when risk levels were high, errors that were judged to be highly embarrassing to the captain were handled as predicted by politeness theory and corrected more indirectly than errors assumed to involve little face-threat.

STUDY TWO

This study was conducted to examine the effect of culture on pilots' preferred communication strategies. 376 pilots (180 captains and 196 first officers) from three European countries (EC-1, EC-2, and EC-3) participated in a study identical to Study One. Table 2 lists participants' professional experience by country. All captains and 192 first officers were male; three was one female first officer each from EC-1 and 2, and two female first officers from EC-3. Pilots who were non-native speakers of English received translated versions of the incident descriptions and task instructions. To assure

equivalence of the study material across languages, all foreign language material was translated back into English and compared with the English original.

TABLE 2

Sample Size And Pilots' Professional Experience By Country

|	EUROPE 1		EUROPE 2		EUROPE 3	
	Capt. N = 68	*F/O* N = 69	*Capt.* N = 81	*F/O* N = 81	*Capt.* N = 31	*F/O* N = 46
Mean Years in Position	9.8	4.6	6.4	6.7	6.6	6.4
Mean Yrs. in Civil Transport	17.4	6.8	26	7.4	20.4	8.8

Method and procedure were identical to Study One. As before, participants were asked to complete a Discourse Completion Task and then a Judgment Task. Pilots' responses in the Discourse Completion Task were coded according to the classification scheme used with the US data set. Coding was done by native speakers who were also fluent in English. One of the raters had also coded the US data set. To assess the reliability of the coding, 25% of the responses to each scenario were randomly selected and independently coded by two judges. Percent agreement between the judges ranged between 89% and 90%.

I. ARE THERE CROSS-CULTURAL DIFFERENCES IN PILOTS' PREFERRED COMMUNICATION STRATEGIES?

The frequencies with which the various communication strategies occurred in the European samples were then compared to the US data set. Two hierarchical log-linear

analyses, one for request strategies and one for speaker-centered communications, were conducted to determine whether pilots' communication strategies varied by culture.
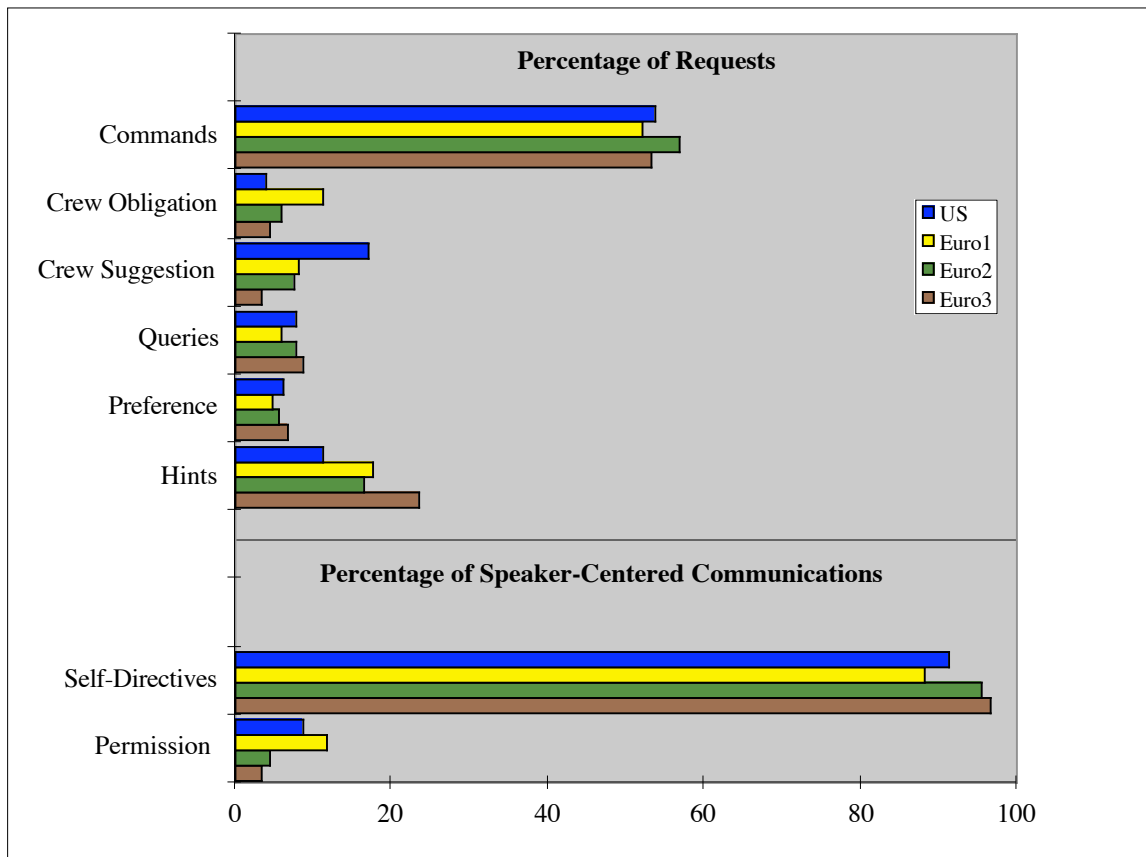
Figure 4. Cross-Cultural Comparison Of Captains' Communication Strategies.

As shown in Figures 4 and 5, the European pilots replicated the findings from the US sample. However, some cross-cultural variations were apparent. Most notably, status-differences between European captains and first officers were less pronounced than those observed for US pilots. European captains were more likely than US captains to correct a first officer's action by simply pointing out the problem to him or by reminding him of a goal. Conversely, European first officers were more likely than their US counterparts to issue commands.
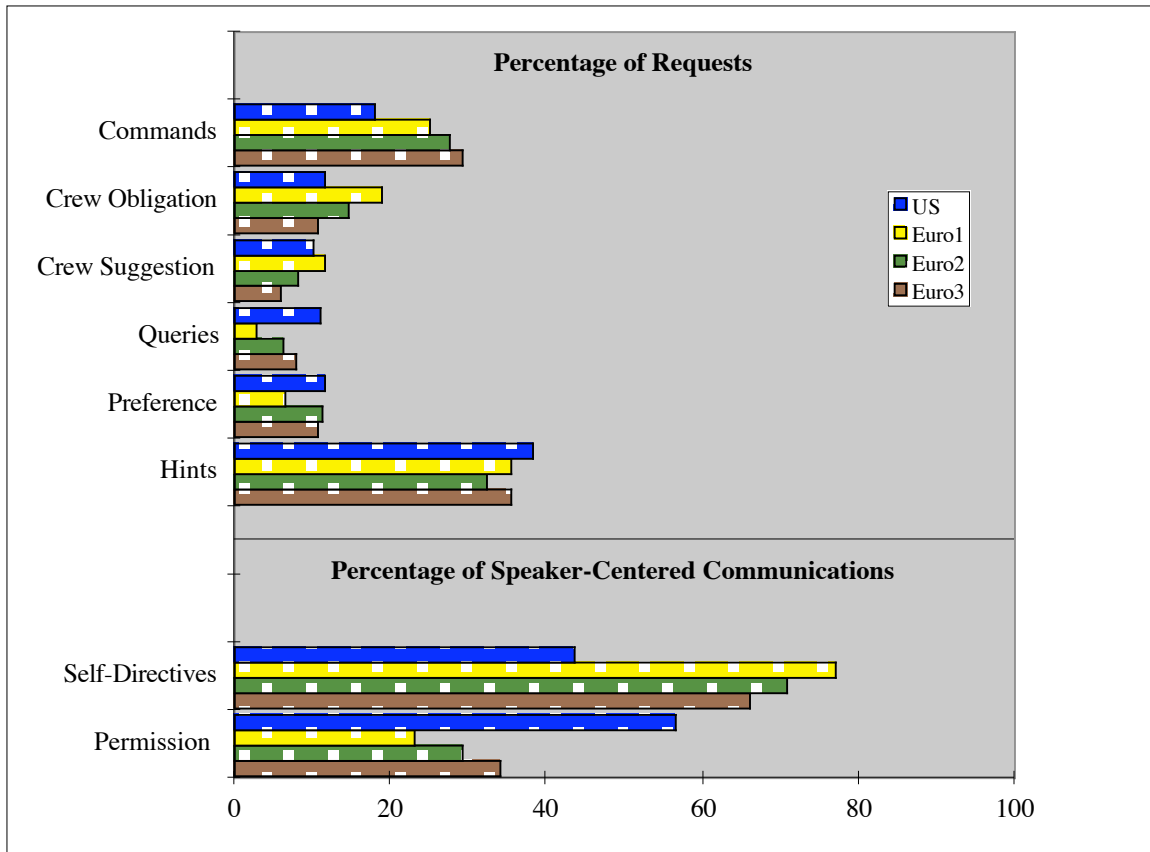
Figure 5. Cross-Cultural Comparison Of First Officers' Communication Strategies.

This finding contrasts with previous research on pilots' attitudes towards leadership (Merritt, 1997). These surveys found low power distance between US captains and first officers, whereas a more hierarchical crew structure was observed for European pilots. Given their attitude data, we expected US and European pilots' communications to differ in the opposite direction than we found. The discrepancy in findings between our study and the attitude research may be the result of differing methodologies. Attitudes are inferred from the extent to which pilots agree or disagree with generic statements such as "Crewmembers shouldn't question the captain unless the safety of the flight is threatened." Answers to these statements may reflect pilots' assessment of how likely it is that they would display the behavior mentioned. Or, the responses may indicate pilots' judgments of the appropriateness of the behavior.

Moreover, attitude studies do not specify how pilots would go about "questioning the captain." Our study, on the other hand, addressed exactly this issue by investigating what specific strategies pilots say they would use and how their strategies correlate with specific aspects of situations.

II. IS THERE CROSS-CULTURAL VARIABILITY CONCERNING PILOTS' RESPONSES TO RISK AND FACE-THREAT?

Subsequent hierarchical log-linear analyses examined the effect of risk level and degree of face-threat on European and US pilots' communications.
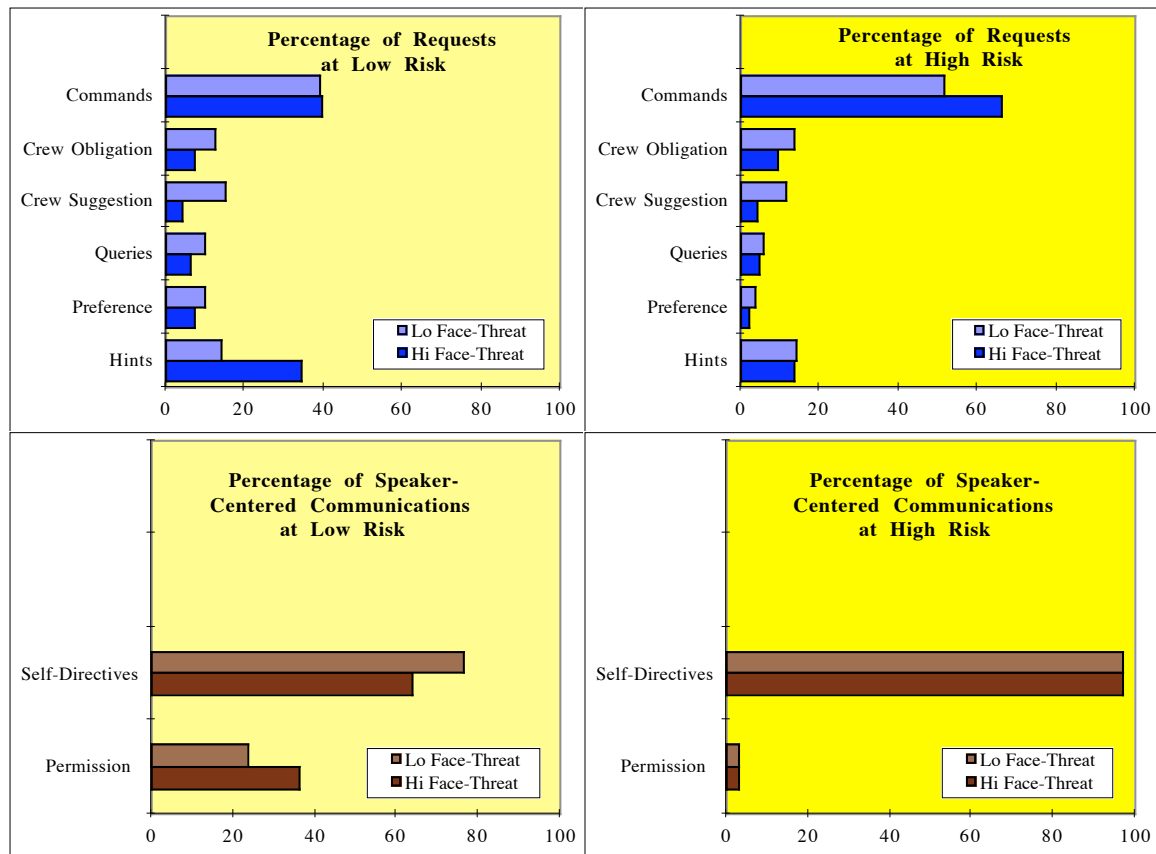
Figure 6. Communication Strategies of Captains' From European Country 1 As A Function Of Risk Level And Degree of Face-Threat.

For these analyses we only included responses of participants for whom risk and face-threat were not significantly correlated. As indicated by their ratings in the Judgment Task, 111 participants from EC-1, 101 from EC-2 and 51 from EC-3 met this requirement. Data from the latter sample were analyzed separately since its small sample size restricted the number of response categories and required a regrouping of categories.
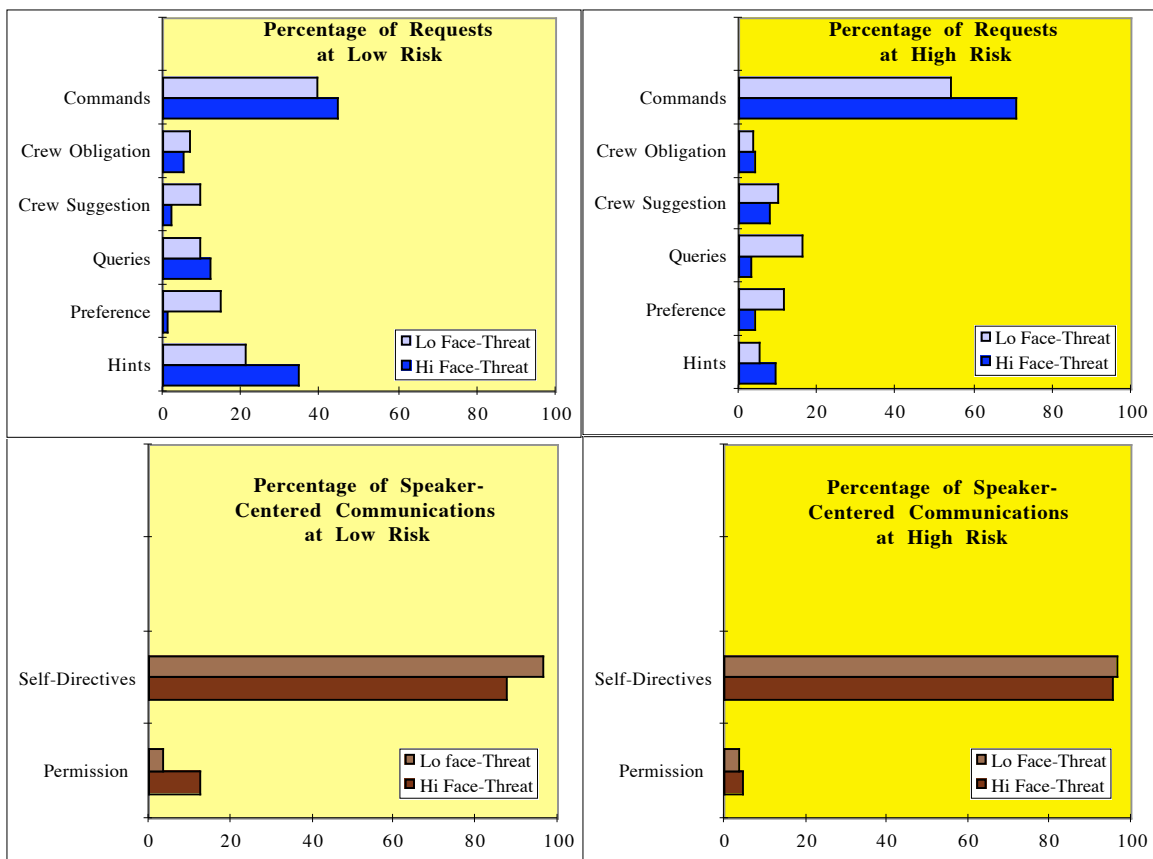
Figure 7. Communication Strategies of Captains' From European Country 2 As A Function Of Risk Level And Degree of Face-Threat.

Cross-cultural differences predominantly concerned first officers' responses to varying levels of risk and face-threat. Responses from European captains to risk and face-threat mirrored the responses obtained from US captains. As can be seen in Figures

6 through 8, captains generally adjusted to higher risk levels by issuing even more commands than in low-risk situations. Though commands were captains' preferred response to both low face-threat and high face-threat errors, they tended to use more hints in situations that were highly embarrassing to the first officer than in less embarrassing incidents. This response pattern was observed for most captains, except for captains from EC-3 who did not show any significant changes with high and low face-threat errors.
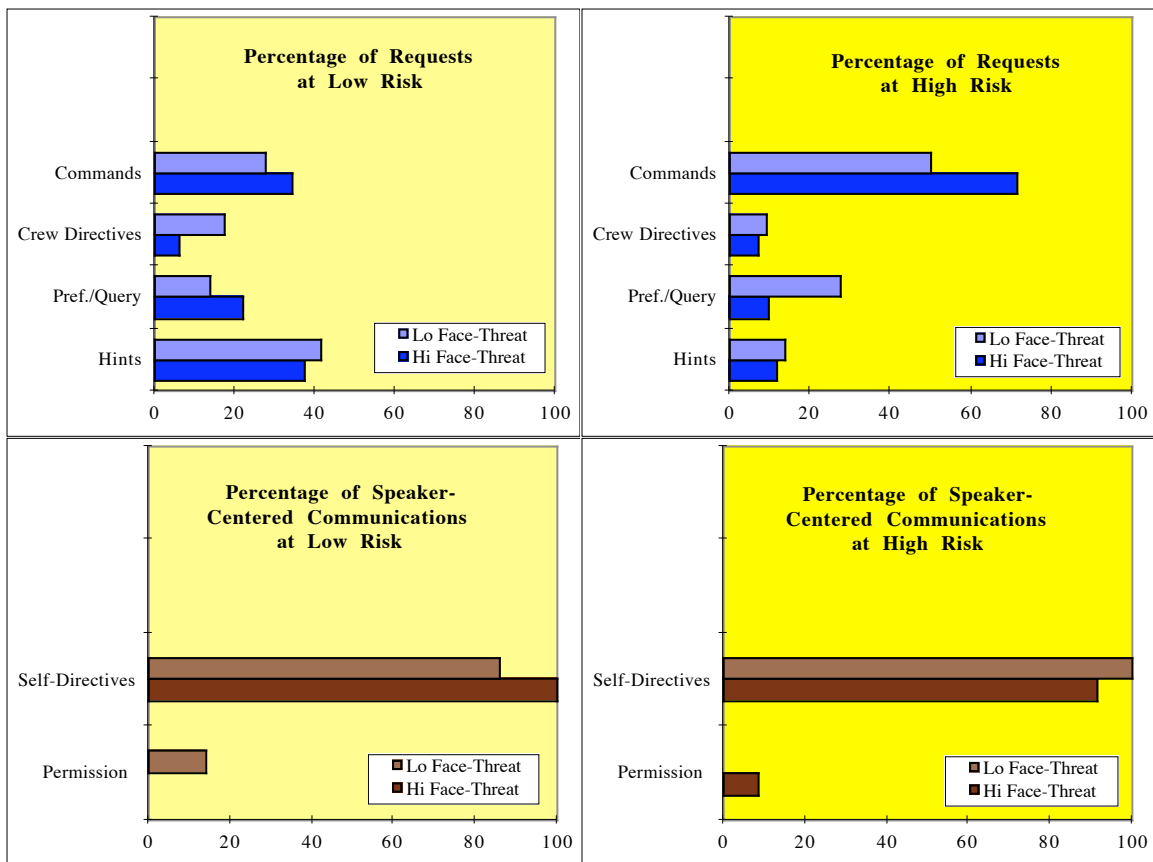
Note: For this group, crew obligation statements and crew suggestions were combined into a new category called 'crew directives;' queries and preference statements were added together as well and treated as one category.

Figure 8. Communication Strategies of Captains' From European Country 3 As A Function Of Risk Level And Degree of Face-Threat.

In contrast to captains, first officers' responses to both situation variables were more varied. As shown in Figures 9, 10, and 11, first officers' responses to high-risk situations fall into three distinct models. The first one entails an increase in crew obligation statements while leaving the preponderance of hints intact, and is exemplified by first officers from the US and EC-1. The second model is exemplified by first officers from EC-3 and involves no significant changes from low- to high-risk situations with hints as predominant strategy. The third model is exemplified by first officers from EC-2 and is characterized by a switch to a more captain-like request style insofar as commands become the dominant strategy in high-risk situations.
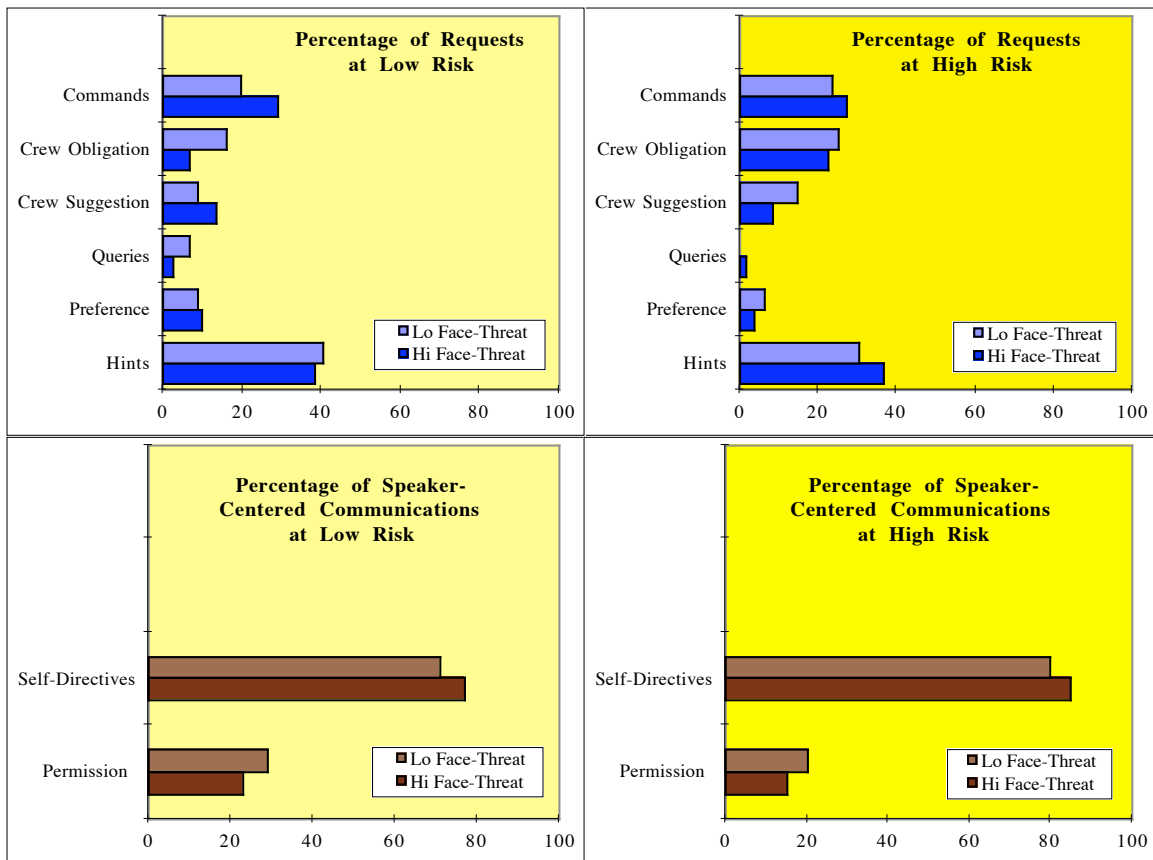
Figure 9. Communication Strategies of First Officers from European Country 1 As A Function Of Risk Level And Degree of Face-Threat.

Varying degrees of face-threat again yielded three distinct responses from first officers. For two groups (EC-1 and 2) request strategies were not significantly affected by the face-threat implied in a pilot error. First officers from the US, in contrast, increased their use of more direct requests while their use of hints, their dominant request strategy, did not vary with face-threat. The remaining group (EC-3) used more hints as well as more commands in response to high face-threat errors by the captain.

Figure 10. Communication Strategies of First Officers from European Country 2 As A Function Of Risk Level And Degree of Face-Threat.

Note: For this group, crew obligation statements and crew suggestions were combined into a new category called 'crew directives;' queries and preference statements were added together as well and treated as one category.
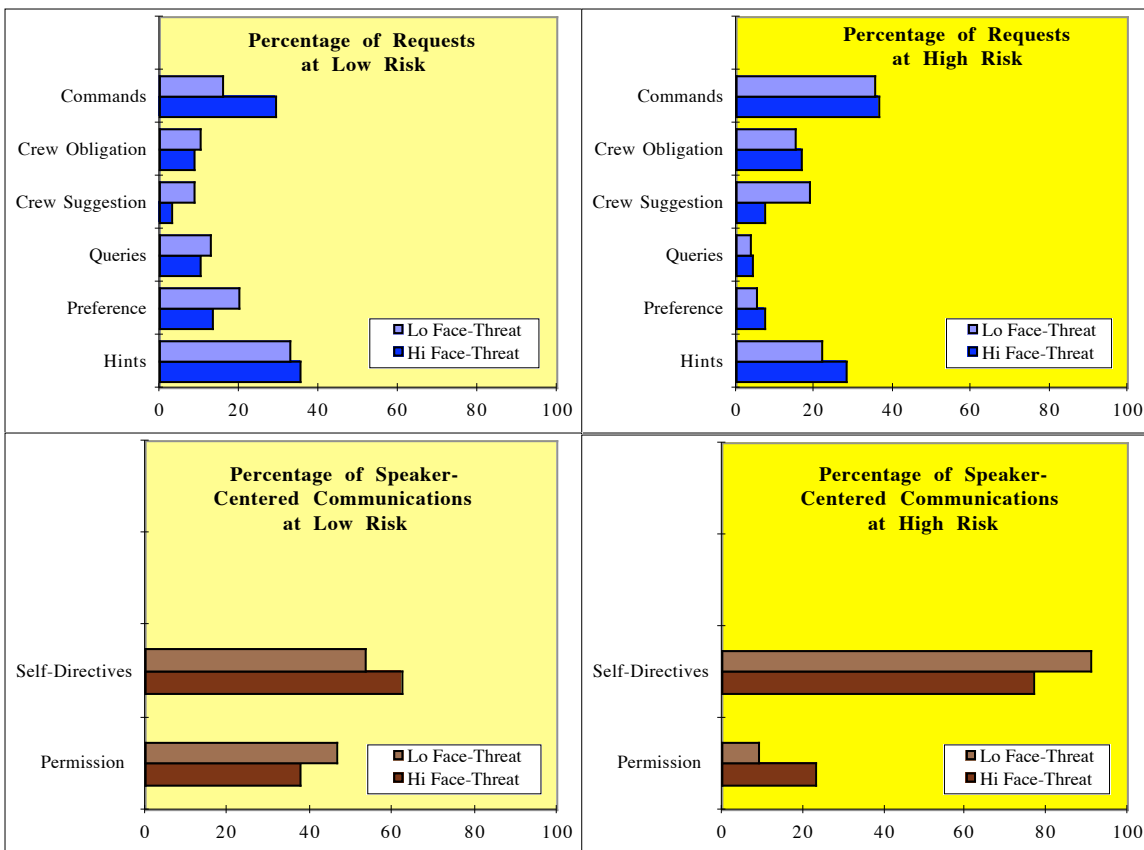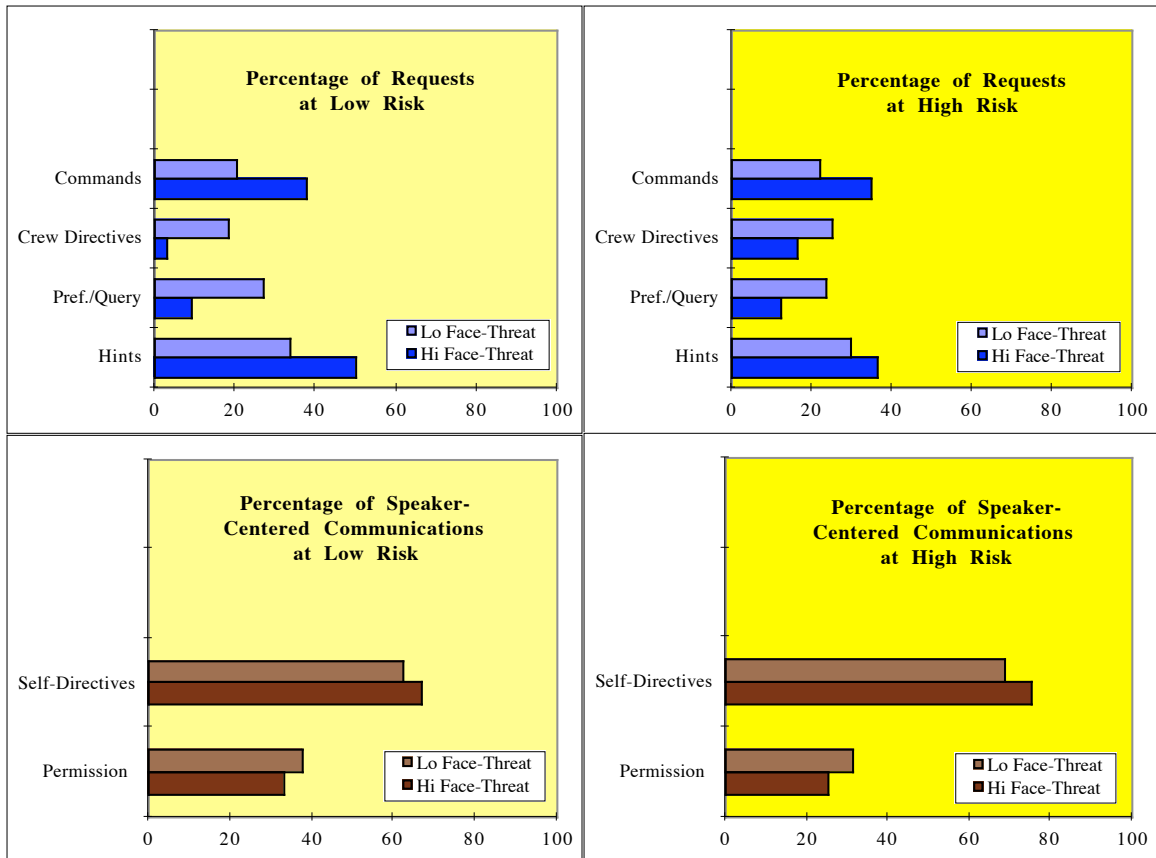
Figure 11. Communication Strategies of First Officers from European Country 3 As A Function Of Risk Level And Degree of Face-Threat.

STUDY THREE

This study examined whether male and female pilots in the US prefer distinct communication strategies to correct an error or a problem on the flight deck. Sociolinguists in the US (e.g., Lakoff, 1975; Tannen, 1994), New Zealand (Holmes, 1995) and Britain (Graddol & Swann, 1989) who observed men and women interact in a variety of formal and informal settings, consistently report differences in language use. Men were found to be more dominant than women; i.e., they tended to talk more, interrupt more often, and were likely to ask more questions and to challenge and disagree with another conversant. Of particular interest to the present research is the finding that American

women of Anglo-Saxon descent favored an indirect conversational style while their male counterparts preferred a direct style. The present study was conducted to examine whether female pilots use more indirect communication strategies than male pilots to mitigate pilot error.

31 female US pilots (12 captains and 19 first officers) participated in a task identical to Study One. The captains had on average 4.9 years of experience in this position and had an average of 13.6 years in Part 121 aircraft. For first officers, position-specific experience averaged 6.6 years and experience in Part 121 2.5 years. Male pilots matching the female sample in terms of years and type of aircraft experience, were selected from the participants in Study One. Position-specific experience and part 121 experience for male captains was on average 4.9 and 24.9 years, and for first officers 5.9 and 9 years, respectively.

Coding of the female pilots' communications followed the procedure employed previously in Studies One and Two; i.e., each response was assigned to one of the eight types of communications listed above in Table 1. As before, responses were also coded in terms of their structure, either simple or complex.

Hierarchical log-linear analyses were conducted to determine whether there was a significant association between gender, position and request strategy, as well as between gender, position and type of speaker-centered communication. Results indicate that status rather than gender influenced pilots' communication strategies. Figure 12 shows that captains, regardless of gender, were more direct in addressing first officers than first officers were in addressing captains. Male and female captains predominantly issued commands to correct the first officer, while first officers generally preferred hints; i.e., problem or goal statements, to get action from the captain. Similar status differences were observed for communications that concerned actions by the speaker. All captains preferred self-directives to permission-requests while first officers showed no particular preference.
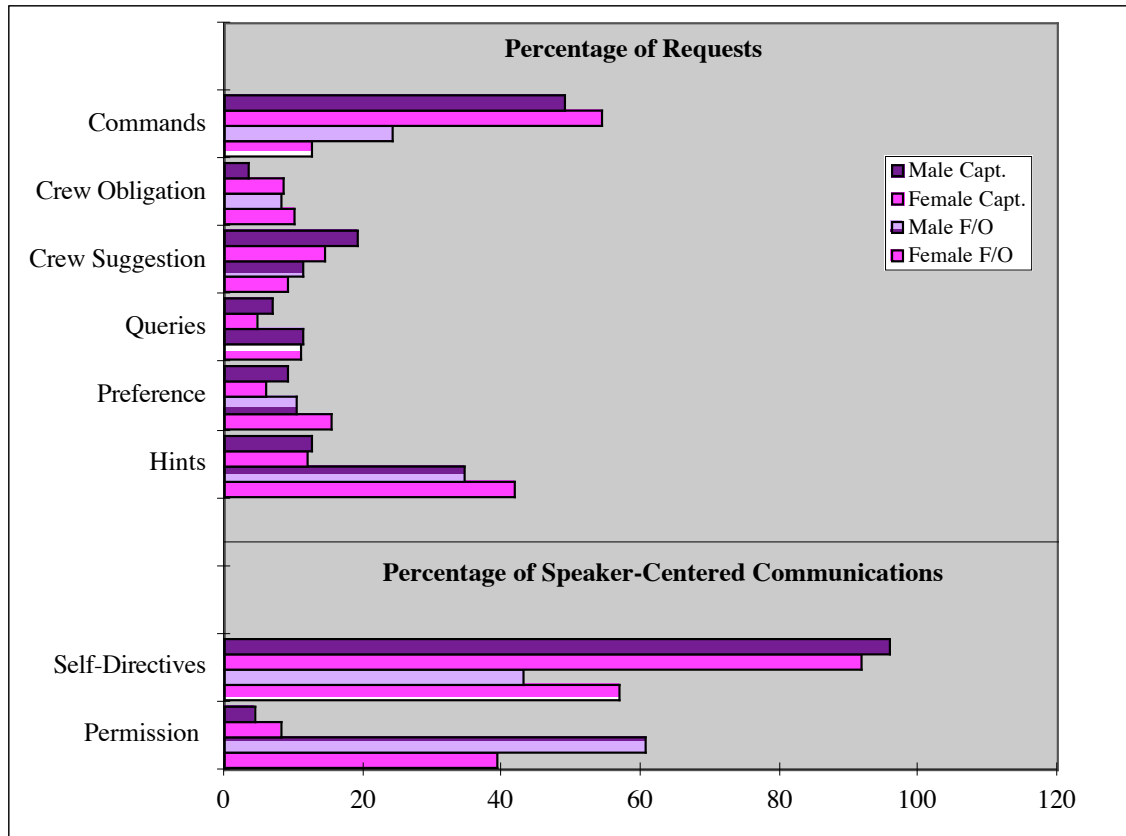
Figure 12. Comparison Of Male And Female Pilots' Communication Strategies.

Additional hierarchical log-linear analyses were conducted to examine whether gender, position and structural complexity of a response were significantly related. These analyses revealed that (1) female pilots were more likely than their male counterparts to support requests and speaker-centered communications with problem or goal statements. and (2) that female pilots predominantly used complex communications; 64% of their requests and 81% of their speaker-centered communications were of this kind. Male pilots, in contrast, used complex and simple constructions equally often.

At first sight these results appear consistent with the view that women are less domineering in social interactions. Accordingly, female pilots' preference for supportive statements is seen to reflect women's inclination to soften the imposition of their

communications. Recall, however, that the larger sample of male pilots in Study One also preferred complex communications to simple response. While a gender-specific interpretation of our results thus seems unfounded, it is still possible to argue that supportive statements are mainly politeness devices that serve to downgrade or soften the effect of an utterance. The argument is that speakers who motivate self- and other-directed communications with some problem or goal, foreground the objective event and thus minimize their role in initiating a corrective action. On the other hand, supportive statements may not - only - be a sign of politeness. Instead, they may provide the broader context necessary for a crew's joint problem solving and decision making (Orasanu, 1994). By placing self- and other-directed communications into a context, speakers ensure that other crew members are able to see why a particular corrective action is required. In addition, 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.

While supportive statements may well have both social and cognitive benefits, either function may be more salient to listeners. In Study Four we therefore investigated how pilots perceive supported communications. Specifically, we examined whether pilots consider supported communications as more polite or as more informative than unsupported communications.

STUDY FOUR

This study had several objectives. We wanted to determine which of the communication strategies discerned in the previous studies 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. Captains had served in this position on average 4.5 years and had flown Part 121 aircraft an average of 15.5 years. First officers' position-specific experience averaged 10.5 years and their Part 121 experience 14.5 years.

Participants received the eight incident descriptions as well as instances of the different communication strategies that we could distinguish in Studies 1 through 3. 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.
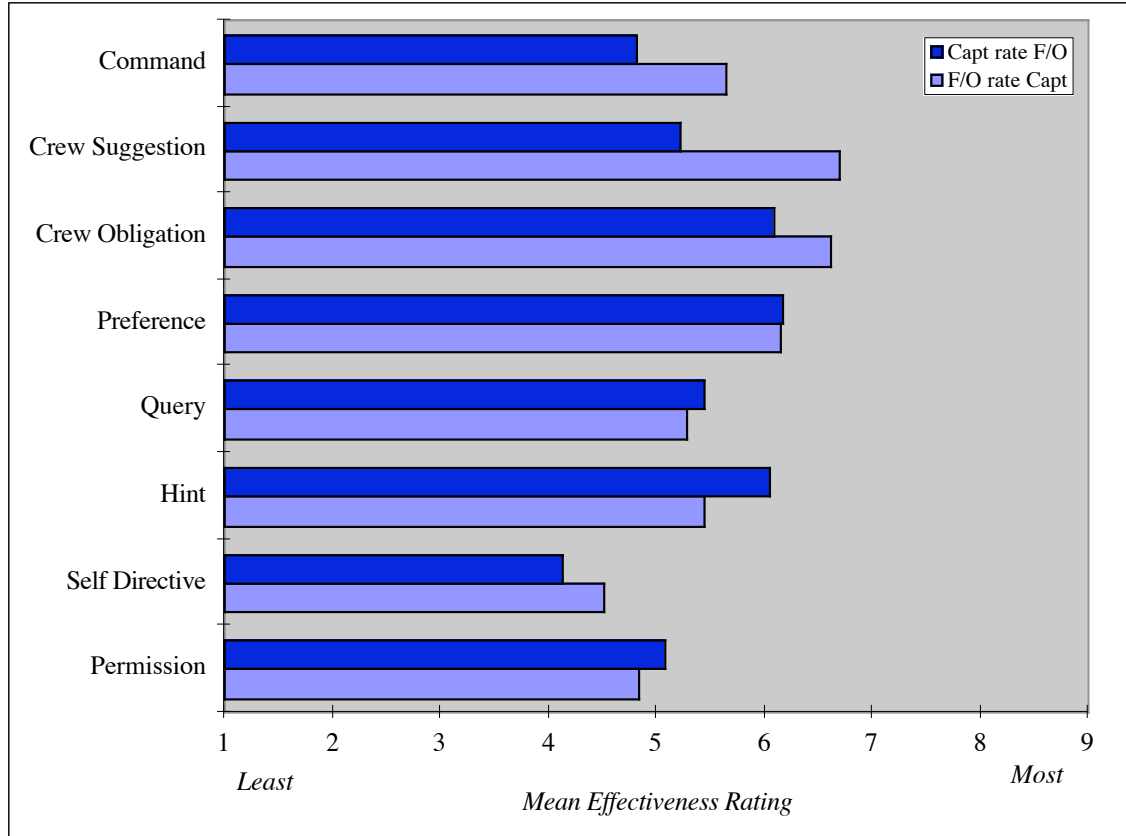
Note: The strategy "Query" comprises data concerning information and intention questions as well as questions inquiring whether the crew should take some action.

Figure 13. Captains' And First Officers' Mean Effectiveness Ratings Of Different Types Of Other-Directed And Speaker-Centered Communications (Aligned From Most To Least Direct)

Two mixed-design analyses of variance were conducted, one on pilots' mean effectiveness ratings for each of the communication types in an incident, and the second one on pilots' mean directness ratings. In these analyses the following statistically significant effects were observed:

(1) Communications that were supported by a problem or goal statement received higher effectiveness ratings (Mean = 6; SD = .41) than unsupported communications (Mean = 5; SD = .42; $F(1,24) = 4.02$, $\underline{p} = .05$). Complex and simple communications, however, were perceived as equally direct ($F(1,24) = .56$, $\underline{ns}$.; M = 6 for both). That is,

pilots thought both constructions were comparable in the extent to which they specified a corrective action and enforced compliance.

(2) Effectiveness ratings of the communication types varied by crew position ($F(8,192) = 8.11$; $p < .000$). However, as shown in Figure 13, 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.

(3) The face-threat inherent in a situation, but not its risk level, significantly influenced pilots' effectiveness ratings of the different communication strategies ($F(8, 192) = 6.78$, $p < .000$; $F(8,192) = 1.34$, ns., respectively). In particular, hints were judged to be more effective when used to correct highly embarrassing mistakes ($M = 7$; $SD = 2.19$) rather than minor errors ($M = 5$; $SD = 2.5$). In high face-threat situations pilots rated this strategy to be as effective as crew obligation ($M = 7$; $SD = 1.9$) and preference statements ($M = 6$; $SD = 2.2$), 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 One 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). 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.

Together, studies 1 through 4 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. Both constructions, however, were deemed comparable in the extent to which they specified a corrective action and enforced

compliance. That is, pilots did not think that complex communications were less forceful than simple statements but rather they perceived them to foster a positive crew climate.

IMPLICATIONS FOR TRAINING

While the present research indicates some cross-cultural variability in pilots' responses to errors on the flight deck, there is also a fairly strong common theme. All pilots, irrespective of nationality, relied on one, status-consistent strategy to request action of another crew member. Training could address the advantages and disadvantages of captains' and first officers' preferred strategies, i.e., of commands and hints, respectively. For example, captains' commands may lead to complacency by the first officer. In commanding action, captains put considerable pressure on first officers to comply. Consequently, first officers might not verify the appropriateness of the requested action, or they might find it difficult to challenge the captain's judgment. This may especially be a danger when commands are not supported by problem or goal statements. Since these supportive statements shift the motivation for the command away from the captain's status to some objective necessity, they may facilitate input by junior crew members. Likewise, there are advantages and disadvantages associated with hints, first officers' main strategy for requesting captain action. As discussed in Study One, first officers' problem and goal statements direct the captain's attention to some objective event that requires correction but leave the decision of what to do, to the captain. While hints are certainly task-relevant communications, they entail the risk that captains will ignore them. Linde (1988), for instance, observed that captains were less likely to act on first officers' suggestions when they were indirect rather than direct communications. This is not to say that hints are necessarily ineffective. Instead, training could identify possible follow-up strategies that first officers could (or should) use if the captain does not respond adequately to their request. Or, training could instruct

captains to be more sensitive to indirect communication strategies of junior crew members (see Tannen,1994b, for a similar argument concerning managers).

A rather different approach to training would entail a shift away from the status-quo to alternative models of crew communication. One such alternative emerged in Study Four when we asked US captains and first officers to rate the effectiveness of various communication strategies. Remarkably, both pilot groups favored communication strategies that appealed to the crew concept rather than to any particular status-based model. Crew obligation statements and preference statements were judged to be highly effective request strategies for captains and first officers. Moreover, both pilot groups rated crew obligation statements to be significantly more effective than commands, even in high-risk situations. In high face-threat incidents both crew obligation statements and hints were considered to be more effective than commands. Common to these strategies is that they address a problem without disrupting the team context. Like commands they explicitly state what should be done. But unlike commands they do not rely on status differences to assure compliance referring instead to the crew members' shared responsibility for coping with problem situations.

If we assume that pilots' effectiveness ratings reflect a valid model of crew discourse, then it is surprising that their communications in studies 1-3 did not follow this model more closely. Specifically, our studies show that while pilots upheld a crew-oriented discourse model in their evaluations, they maintained a status-based discourse model in their productions. This discrepancy may indicate that pilots find it difficult to overcome ingrained norms for interacting with superiors and subordinates and to translate an abstract notion like "crew concept" into specific communication strategies. Consequently pilots may benefit from training initiatives that facilitate this translation process; i.e., training approaches that provide examples of crew-oriented communication strategies and that coach pilots in these strategies. This kind of training, moreover, would not seek to "up-grade" first officers to a captain-like communication style but

rather to get both captains and first officers attuned to communication strategies that are supportive of team work.

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APPENDIX A

INCIDENT DESCRIPTIONS USED IN STUDIES 1 THROUGH 4

Note that incidents are described from the perspective of a captain participant. The first officer version is identical except that the captain is the pilot flying. Captain and first officer participants received either the low risk or the high risk version of an incident.

INCIDENT 1: LOW FACE-THREAT

LOW-RISK VERSION
First Officer Bob Fisher is flying this leg. While cruising in VMC at FL 350, you realize that your aircraft is still flying a previously given vector heading and that ATC has failed to give you a heading back on course. Your aircraft is now 50 miles off course. F/O Fisher has apparently not yet noticed that there is a problem.

HIGH-RISK VERSION
First Officer Bob Fisher is flying this leg. As you descend through 10,000 ft. into an airport surrounded by mountainous terrain topping 8,000 ft., you realize that your aircraft is still flying a previously given vector heading and that ATC has failed to give you a heading back on course. Your aircraft is now 50 miles off course. F/O Fisher has apparently not yet noticed that there is a problem.

You want to ensure that your aircraft gets back on course. Please write out <u>verbatim</u> what you would say to the First Officer.

INCIDENT 2: LOW FACE-THREAT

LOW-RISK VERSION
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.

HIGH-RISK VERSION
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.

INCIDENT 3: LOW FACE-THREAT

LOW-RISK VERSION
Your aircraft is on descent at 10,000 ft. in VMC. Your present heading is 360 when ATC gives you a vector for traffic and directs you to turn right to 330. First Officer Andrew Collins begins a right hand turn as the controller gets back to you and admits he had made a mistake and would like you to make a left hand turn. F/O Collins apparently did not hear this clarification and continues with a right turn.

HIGH-RISK VERSION
Your aircraft has been cleared for takeoff. Previous aircraft reported lightning off the right during departure. At 1,500 ft., shortly after takeoff on runway 36, departure control directs you to turn right to 330. First Officer Andrew Collins begins a right hand turn as the controller gets back to you and admits he had made a mistake and would like you to make a left hand turn. F/O Collins apparently did not hear this clarification and continues with a right turn.

You want to ensure that your aircraft is making a left turn.

INCIDENT 4: LOW FACE-THREAT

LOW-RISK VERSION
First Officer Martin Wilson is flying the airplane. Enroute, air traffic control asks your estimated time of arrival to waypoint Charlie, a point that is not on your flight plan. At this moment, you realize that both of you had misunderstood a previous clearance and that you are now several miles off course.

HIGH-RISK VERSION
First Officer Martin Wilson is flying the airplane. While descending through 12,000 ft. in IMC into an airport surrounded by mountainous terrain topping 10,000 ft., air traffic control asks your estimated time of arrival to waypoint Charlie, a point that is not on your flight plan. At this moment, you realize that both of you had misunderstood a previous clearance and that you are now several miles off course.

You want to ensure that your aircraft returns to its correct course.

INCIDENT 5: HIGH FACE-THREAT

LOW-RISK VERSION
First Officer John Smith is flying the aircraft. After takeoff, departure control clears you to climb and maintain 9,000 ft. MSL. At 8,500 ft., you are advised of traffic at 10 o'clock climbing through 12,000 ft. After spotting the traffic, you scan the instruments and notice that F/O Smith is climbing through 9,200 ft. at a rate of 1,200 ft./min.

HIGH-RISK VERSION
First Officer John Smith is flying the aircraft. After takeoff, departure control clears you to climb and maintain 9,000 ft. MSL. At 8,500 ft., you are advised of traffic slightly to your left at 12,000 ft. After spotting the traffic, you scan the instruments and notice that F/O Smith is climbing through 9,800 ft. at a rate of 2,800 ft./min.

You want to ensure that your aircraft returns to its assigned altitude.

INCIDENT 6: HIGH FACE-THREAT

LOW-RISK VERSION
You are on a long haul flight in VMC. While at cruise altitude, you notice that the autopilot is behaving erratically and that First Officer George Miller, who is pilot flying, has fallen asleep.

HIGH-RISK VERSION
You are on a long haul flight in IMC. Previous aircraft reported moderate icing during descent. When approaching top of descent, you notice that the autopilot is behaving erratically and that First Officer George Miller, who is pilot flying, has fallen asleep.

You want to wake up the First Officer.

INCIDENT 7: HIGH FACE-THREAT

LOW-RISK VERSION
During the approach into your destination, the controller reports rain showers and that the aircraft 5 miles in front of you experienced moderate turbulence on short final. At 1,000 ft., you notice that First Officer Rick Adams is flying at the minimum approach speed although during briefing you had agreed to fly the approach at V_{Ref} plus 15 kts.

HIGH-RISK VERSION
During the approach into your destination, the controller reports that the aircraft 5 miles in front of you experienced windshear and an airspeed loss of 10 knots on short final and that a thunderstorm is located 15 miles off the departure end of the landing runway. At

500 ft, you notice that First Officer Rick Adams is flying at the minimum approach speed although during briefing you had agreed to fly the approach at V_{Ref} plus 15 kts.

You want to ensure that your aircraft is flying at the correct approach speed.

INCIDENT 8: HIGH FACE-THREAT

LOW-RISK VERSION
During a VFR approach, the controller instructs you to intercept the localizer course and to track it inbound toward the runway. The controller also informs you that parallel approaches are being flown to the adjacent runway on the right. You notice that First Officer Paul Baker is flying 1 dot left of course and is not correcting for it.

HIGH-RISK VERSION
During an IFR approach, the controller instructs you to intercept the localizer course and to track it inbound toward the runway. The controller also informs you that parallel approaches are being flown to the adjacent runway on the left. You notice that First Officer Paul Baker is flying 1 1/2 dots left of course and is heading toward the adjacent runway's approach corridor.

You want to get your aircraft back on the correct final approach course.

APPENDIX B

EXAMPLE FOR THE MATERIAL USED IN STUDY 4 (RATING STUDY)

NASA 133 is on approach into its destination when the controller reports that the aircraft 5 miles in front experienced windshear and an airspeed loss of 10 knots on short final and that a thunderstorm is located 15 miles off the departure end of the landing runway. At 500 ft, First Officer Welch notices that Captain Rick Adams is flying at the minimum approach speed although during briefing the crew had agreed to fly the approach at V_{Ref} plus 15 kts.

1.1. Effectiveness
Imagine you are Captain Adams, and First Officer Welch is talking to you. How *effective* is each communication in *ensuring that the <u>aircraft</u> is <u>flying</u> the approach at <u>V_{Ref} plus 15</u> while <u>assuring</u> <u>your</u> <u>cooperation</u>?*

(Please read through the entire set of F/O responses first before assigning your rating.)

1.2. Directness
Imagine you are Captain Adams, and First Officer Welch is talking to you. F/O Welch wants to *ensure that the <u>aircraft</u> is <u>flying</u> the approach at <u>V_{Ref} plus 15</u>. How <u>direct</u> is he <u>in communicating</u> his intention?*

(Please read through the entire set of F/O responses first before assigning your rating.)

2.1. **Without Supporting Context**:

1 ---> 9

Let's pick up that speed to V_{Ref} +15.	
Are you still planning on flying Ref + 15?	
Increase your speed to V_{Ref} + 15.	
Do you want me to add 15 kts?	
We need to bump our speed up 15 kts.	
I'll set the bug there for you to Ref +15.	
Are we still going to fly V_{Ref} +15?	
How about adding 15 kts?	
I show you 15 kts slow.	

2. 2. With Supporting Context

1 ---> 9

Are we still going to fly V_{Ref} +15 for the windshear ahead?	
I show you 15 kts slow. They advised windshear on final.	
I'll set the bug there for you to Ref +15 because of the windshear ahead.	
Increase your speed to V_{Ref} + 15. They advised windshear on final.	
Are you still planning on flying Ref + 15 for the windshear ahead?	
Do you want me to add 15 kts? They advised windshear on final.	
Let's pick up that speed to V_{Ref} +15 due to the windshear ahead.	
We need to bump our speed up 15 kts for the windshear ahead.	
How about adding 15 kts for the windshear ahead?	

1.1. RATING SCALE

- 1 least effective. *The communication is tactless, excessive, or inappropriate.*

- 5 moderately effective. *The communication is reasonably tactful and appropriate.*

- 9 most effective. *The communication is highly appropriate to the problem and maintains positive crew climate.*

1.2. RATING SCALE

- 1 least direct. *Not apparent from what has been said what the F/O wants done; no explicit commitment to a particular action and/or pressure on you to act.*

- 5 moderately direct. *Clear what the F/O wants done; F/O expresses some commitment to this action and/or moderate pressure on you to act.*

- 9 most direct. *Blunt; explicit about what needs to be done and by whom; F/O expresses strong commitment to the action and/or strong pressure on you to act.*