CULTURAL VARIABILITY IN CREW COMMUNICATION

Second Year Report

on Cooperative Agreement No. NCC 2-933

by
Ute Fischer

Covering the period from October 1, 1996 until September 30, 1997

School of Literature, Communication and Culture
Georgia Institute of Technology
ATLANTA, Georgia 30332-0165

Abstract

Our research efforts in year 2 had the following objectives:
- Determine whether there are status- and gender-related variations in monitoring and challenging strategies employed by U.S. pilots
- Expand the project to non-U.S. pilots

Progress on each of these objectives will be described in the following sections.

Are there status-based differences in monitoring and challenging strategies?

Participants

1000 test booklets were mailed to representatives of three major U.S. carriers who distributed the material among their pilots. 161 pilots returned the material. Of these, 9 responses by captains and 8 by first officers had to be excluded since they failed to comply with the instructions, either by skipping scenarios or by providing non-verbatim responses. Of the remaining 63 captain participants, 21 were from airline 1, 17 from airline 2, and 25 from airline 3. Of the remaining 81 first officer participants, 27 were from airline 1, 22 from airline 2, and 32 from airline 3.

Material

The experimental material was developed and pretested during year 1 of this research project as detailed in last year's progress report, and will thus only be summarized here. A test booklet consisted of eight short vignettes, each printed on a separate page. The vignettes described aviation incidents which varied in type and severity. For captain participants, incidents were narrated from the perspective of the captain and involved errors or oversights of the first officer, the pilot-flying. The reverse set-up was used in booklets designed for first officer participants. Random ordering of the vignettes yielded 16 different captains' and first officers' editions.

Method and Procedure

There were two tasks: a Discourse Completion Task and then a Judgment Task. In the Discourse Completion Task, participants received the incident descriptions followed by a goal statement. Participants were asked to imagine themselves in the position of the captain (or the first officer - dependent on the crew position of the participant) and to write out verbatim what they would say to the first officer (or the captain) in order to achieve the stated goal. In the Judgment Task, participants were asked to rate the scenarios along various scales, such as threat to flight safety. Ratings along the scales could range from 1 to 9.

Analyses

Request Types. The coding scheme developed during the pretesting of the material was adopted for this larger data set; except for a few changes aimed at systematizing earlier categories. Previously we had distinguished between two major classes of communications: those that referred to actions to be taken by the speaker himself and those in which the speaker requested actions to be taken by the listener. Included in this latter category were communications addressing crew actions. In the revised coding scheme, we treated crew-centered communications as a separate category. As previously, these major categories were further divided into sub-classes of communications based on the extent to which they committed the speaker, the listener, or the crew to a particular action.

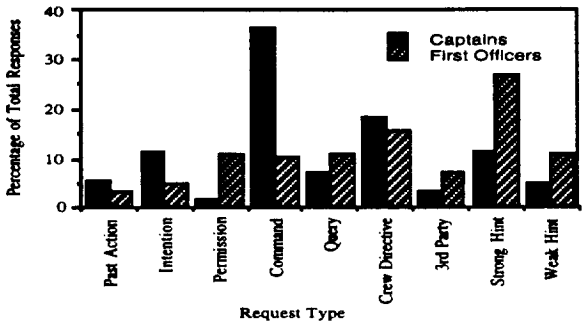
Complexity of the communications. As was done for the preliminary data, we noted whether the responses were simple or complex. Complex communications consisted of several utterances. Typically one of them was the principal part, or primary move, that realized the goal stated after each incident description, and the other parts provided justification. A variation of complex responses consisted of several primary moves which together realized the stated intention but in which one also gave a rationale for the other. Simple communications, in contrast, were responses in which a given goal was realized by a single utterance, i.e., a single primary move.

Results and Discussion

Request types. Captains and first officers used distinct request strategies. As can be seen in Figure 1, the request types were differently distributed across the two groups

(X^2(8, N = 1569) = 273.96; p < .0001). Captains most frequently issued commands. 36% of their requests were of this type as compared to 10% for first officers. First officers' predominant strategy, in contrast, was to alert the captain to a problem or to remind him of a given target speed or altitude. 27% of the first officers' requests were strong hints, i.e.; alerts, problem and goal statements. Eleven percent of the captains' communications fell into this category.

Figure 1: Distribution of Request Types used by Captains and First Officers



Captains from the three airlines were consistent in their preferences for the various request types; however, the captain groups differed in the extent to which they adopted the strategies (X^2(16, N = 755) = 33.46; p < .01). Similarly, first officers from the three airlines agreed in their most frequent strategies but differed in their overall distribution (X^2(16, N = 814) = 48.62; p < .0001). This difference appears to be predominately due to the use of commands: first officers from airline 3 issued commands 4.5% of the time as compared to 14.6% and 13% for first officers from airlines 1 and 2.

Complexity of the communications. A 3 (airline) x 2 (crew position) analysis of variance on the number of complex communications was performed. There was a main effect of airline (F(2,138) = 4.86; p < .01) and of crew position (F(1,138) = 6.04; p < .05). The first main effect implies that if captains and first officers are considered together, pilots from the three airlines differed in the extent to which they used complex rather than simple communications. Pairwise Scheffe tests revealed that pilots from airline 1 made more complex communications than pilots from airline 3. This effect may reflect differences in company policy or it may be accounted for in terms of differences in aviation experience. Follow-up analyses are planned to investigate the impact of years of aviation experience in this context.

In addition to an airline effect, we also found that crew position influenced the structure of pilot communication. Complex communications were more frequent for captains (M = 5) than for first officers (M = 4). Further analyses revealed that complex communications frequently involved some fairly direct request in conjunction with some form of justification. 68% of commands by captains occurred in complex rather than in simple communications. Command plus reference to some problem or goal that necessitates the command is certainly a very explicit form of communication. In addition to its informativeness, there are also social benefits. By providing some objective reason for their commands, captains shift the locus of control away from their status to some external need and thus mitigate the social impact of the command. The social function of complex communications is even more apparent in first officers' speech. If they used direct request strategies, then they also provided some justification. For instance, 83% of their

commands and 72% of their crew directives were embedded in complex constructions. Less direct strategies, such as queries, could occur either in complex (51%) or in simple constructions (49%). Indirect requests were mainly done in simple constructions (70%).

Are there gender-specific differences in strategy use?

Our research on this issue has been described in a paper entitled "How to challenge the captain's actions" that we presented at the Ninth International Symposium on Aviation Psychology. Since a copy of this paper can be found in Appendix A, only a brief summary of the results will be given here, followed by a description of analyses that have been done since the publication.

Unlike previous work on gender differences in communication strategies, we did not find that female pilots were more indirect than male pilots. In our study, directness and indirectness were aligned with status not with gender. However, we did find gender differences among pilots with respect to the structure of their communications. Female pilots, in particular female captains, were more likely than their male colleagues to motivate their requests by referring to some objective need.

In subsequent analyses we investigated whether male and female pilots varied their request strategies and the structure of their communications with the perceived risk of a situation. For each participant, we divided the scenarios into three categories based on his or her ratings: low risk situations had a rating between 1 and 3, medium risk situations between 4 and 6, and high risk situations between 7 and 9. We then tallied the various request types that participants gave in response to low-, medium, and high-risk situations and found that perceived risk did not affect female captains' and first officers' choice of request type ($X^2(16, N = 108) = 15.07$; ns., and $X^2(16, N = 103) = 20.29$; ns.; respectively). However, male captains and first officers preferred different request types dependent on their perception of risk ($X^2(14, N = 102) = 27.05$; $p < .05$, for captains, and $X^2(16, N = 101) = 38.29$; $p < .01$ for first officers). In particular, male captains issued more commands, the riskier the situation. In low risk situations, 5% of their requests were commands versus 41 and 49 percent in medium and high risk situations. Male first officers also increased the directness of their communications in response to risky situations. In low risk situations, 23% of their requests were observations and 19% were problem statements. In medium risk situations, in contrast, they employed most frequently queries and problem statements (both 23%), and in high risk situations problem statements (30%) as well as crew directives (20%).

The structure of the communications were also affected by perceived risk; but significantly only for female captains ($X^2(2, N = 80) = 6.86$; $p < .05$). This group of pilots used complex and simple constructions evenly in response to low risk situations (55 and 45 percent). However, in medium and high risk situations they preferred complex constructions (87.5 and 82 percent, respectively). Male captains showed the tendency to employ simple constructions in low risk situations (72%) and to balance their use of simple and complex communications once perceived risk increased. A similar trend was observed for male first officers. For female first officers, use of complex constructions peaked in medium risk situations (69%) and leveled around 50% in low and high risk situations.

Expanding the project to non-U.S. pilots

Presently the study is being conducted in Switzerland, Germany and Great Britain. A total of 2880 test booklets have been mailed out to representatives of airlines and pilot unions. Completed booklets are expected to be received by the end of the summer.

For British participants, only minor changes in the test material was necessary to accommodate British standards of wording and spelling. For German-speaking participants, all material was translated into German by a native speaker. The German version was then back-translated into English by a second bilingual speaker. No semantic differences were found between the back-translation and the original English version. The

German version was further checked by several Swiss and German pilots for accuracy of aviation terminology and acceptability of the scenarios to their flight experience. Several changes were implemented but care was taken to leave the nature of the scenarios unaltered. The German version of the material is provided in appendix B.

Appendix A

HOW TO CHALLENGE THE CAPTAIN'S ACTIONS

Ute Fischer*
Georgia Institute of Technology

Judith Orasanu**
NASA-Ames Research Center

On January 13, 1982 an Air Florida Boeing 737 crashed into the Potomac River due to excessive snow and ice on the airplane and a frozen indicator which gave the crew a false engine power reading. The aircraft had been de-iced, but 45 minutes had elapsed before it was cleared for takeoff. The captain had little experience flying in winter weather. While awaiting their takeoff clearance, the following conversation took place between the crew (NTSB, 1982):

First Officer:	*Look how the ice is just hanging on his, ah, back, back there, see that?*
	(...)
First Officer:	*See all those icicles on the back there and everything?*
Captain:	*Yeah.*

After a long wait following de-icing, the first officer continued:

First Officer:	*Boy, this is a, this is a losing battle here on trying to de-ice those things, it (gives) you a false feeling of security, that's all that it does.*

Shortly after being given clearance to take off, the first officer again expressed his concern:

First Officer:	*Let's check those tops again since we've been sitting here awhile.*
Captain:	*I think we get to go here in a minute.*

Finally, while they were on their takeoff roll, the first officer noticed that something was wrong with the engine readings.

First Officer:	*That don't seem right, does it?* [three second pause] *Ah, that's not right . .*
Captain:	*Yes, it is, there's 80.*
First Officer:	*Naw, I don't think that's right.* [seven-second pause] *Ah, maybe it is.*
Captain:	*Hundred and twenty.*
First Officer:	*I don't know.*

The first officer's references to "ice," "icicles," and "false sense of security" indicate that he was apparently quite aware of the dangerous weather conditions. Yet he did not succeed in getting the captain to take his concerns seriously or to act on them. Nor did he succeed in convincing the captain that there was something wrong with the engine power reading.

Why were the first officer's communications unsuccessful? One possible reason might be that he used indirect speech. He only hinted at the possibility of a problem rather than stating explicitly what he suspected and what he thought should be done; nor did he challenge the captain's decision to continue with the takeoff. There are two potential problems associated with indirect language use. (1) While direct, explicit utterances have only one meaning, indirect utterances have at least two: one meaning concerns what speakers explicitly say; the other concerns what they actually mean. Listeners thus have to infer what speakers mean from what is explicitly said (Searle, 1975), and they may err in this point. Most notably, listeners may not realize the indirectness of an utterance and may instead take an utterance at face value, thus misunderstanding what speakers intended. (2) Indirect speech is less forceful and more polite than direct speech. Listeners, on the other hand, may mistake politeness for indecisiveness and consequently may not take the implied intention seriously enough. This problem was prevalent in an analysis of crew discourse by Linde (1988) who observed that captains were less likely to act on first officers' suggestions when they were indirect than when they were direct.

---

* Work supported by NASA cooperative agreement No. NCC 2-933
** Work supported by NASA, Code UL

From Linde's (1988) observations we may be inclined to conclude that effective communication between crew members ought to be maximally explicit and direct. 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 addressee. 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. How speakers can best assure listener cooperation varies with their relationship. Superiors, by virtue of their social status, may be licensed to give direct commands to their subordinates. However, 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, as we elaborated above, by being indirect, subordinates run the risk of being misunderstood or of not being heard.

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 was the topic of our present research. In this research project we attempted to understand how first officers could effectively challenge the actions of captains, and how first officers' and captains' strategies differ. In addition, we were interested in determining whether male and female pilots have distinct notions of what constitutes effective behavior in this context. Sociolinguistic studies on gender differences in discourse strategies have reported that men are more explicit, directive and task-oriented than women. Talk by women has been characterized as indirect and concerned with relational aspects of interactions (Lakoff, 1975; Tannen, 1990, 1992). In this research we wanted to see whether these observations generalize to crew discourse.

METHOD

Participants

Female pilots were recruited by placing a call for participation in the ISA newsletter. 21 pilots responded to the ad and completed the experimental material. There were 10 captains and 11 first officers. The captains had on average 3.6 years in this position and had an average of 11 years of experience in Part 121 aircraft. For the first officers, position-specific experience was on average 6.3 years, and experience in Part 121 was 8.9 years.

Male pilots matching the female sample in experience, were taken from a larger sample of 162 male respondents. The 10 male captains that were selected had on average 3.6 years of experience in this position and 14 years of experience in part 121. Position-specific experience and part 121 experience for first officers was on average 5.7 and 8.6 years, respectively.

Material

Eight short vignettes were constructed that described aviation incidents. These incidents varied in type and severity of a problem. For captain participants, incidents were described from the perspective of the captain and involved errors or oversights of the first officer, the pilot-flying. The reverse was true for first officer participants. The vignettes were printed in a test booklet, one vignette per page. There was a captain edition and a first officers' edition. Random orders of the vignettes were created yielding 16 differently ordered captains' and first officers' booklets.

Method and Procedure

Participants were asked to complete two tasks: a Discourse Completion Task and then a Judgment Task. In the Discourse Completion Task, participants received the incident descriptions and were asked to imagine themselves in the position of the captain (or first officer - dependent on the crew position of the participant). Each incident description was followed by a goal statement and the participants were asked to write out verbatim what they would say to 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.
> *You want to ensure that your aircraft will not penetrate this area.*

The second part of a test booklet consisted of a Judgment Task in which participants rated the scenarios along various scales, such as problem severity. Results from the judgment task will not be reported in this paper.

Analyses

Request types. Recall that each incident description was followed by a goal statement that should be realized by the participants' communications. In coding the responses we therefore noted whether a speaker specified what action should be taken and whether the action is to be taken by him- or herself, the listener, or by the crew (Blum-Kulka, 1987; Clark, 1979). Responses were further classified based on the extent to which they committed the speaker, the listener or the crew to a particular action (Herrmann & Grabowski, 1994). For example, compare "*I'll call ATC*" with "*Do you want me to call ATC*?" In the former utterance, the speaker expresses a strong commitment to calling ATC and virtually takes the listener's acceptance for granted. Speaker commitment is much weaker in the latter utterance with which the speaker seeks the listener's permission to call ATC. Similarly, "*Turn left for the weather*" and "*Do you want to turn right or left around this weather*?" place the listener under different obligations to comply with the speaker's intentions. The major categories that we distinguished are summarized in Table 1:

TABLE 1
Examples of Request Types

Commands & Statements of Intent *3rd Party Commands*	-- Turn right back to the localizer. -- I'll call ATC -- He (= controller) wants us to turn left now.
Suggestions	-- Let's correct back on course.
Confirmation-Seeking Questions	--Didn't you want to fly at V-Ref plus 15 for winds?
Permission-Seeking Questions	-- Should I ask ATC if he'll give us direct?
Alerters	--Watch your speed! -- Altitude!
Strong Hints *Problem Statements & Problem Inquiries* *Goal Statements*	 -- We're well left of course and there is parallel traffic. -- Do you think they still want us on this heading? -- We were assigned 9000 ft.
Mild Hints *Observations and Questions*	 -- Do we have anyone on the approach for the parallel runway?

Complexity of the communications. Participants could use either one or several utterances to achieve the goal that was stated after each incident description. If there were several utterances we noted their relationship. Typically one utterance was the principal part, or primary move, that realized the stated intention, and the other parts provided justification. Consider for example the following response: "*We've got parallel traffic off our left.* Turn right heading xxx *to intercept the localizer.*" Here the goal of getting the aircraft back on the assigned approach course is realized by the command. The italicized segments provide reasons for the command and are thus supportive moves. We called responses involving primary and supportive moves, complex communications. A variation of complex responses consisted of several primary moves which together realized the stated intention but in which one also gave a rationale for the other. For example in "*What's your plan with regard to the weather? We should turn soon,*" the second part not only constrains what should be done concerning the weather (= the goal) but also justifies why the question has been asked in the first place. Simple communications were responses in which a given goal was realized by a single utterance, i.e., a single primary move, as in "*Level off now!*" or "*Would you like me to request direct?*" Alternatively, simple communications could also involve several primary moves which provided distinct directives, for example when speakers allocated responsibilities as in "*Level off here. I'll call ATC.*"

RESULTS

Reliability of coding. Two coders independently classified responses by 10 participants. Percent agreement was calculated on their ratings and found to be 91%. One coder subsequently classified the remaining responses.

Do captains and first officers use different request types? The answer to this question is yes. Captains used most frequently commands (37%), suggestions of the "Let's type" (19%), or stated their intention to perform some action (14%). The majority of the intention statements, however, were combined with commands (e.g., "*Climb immediately to 12,000. Then I'll check our course*!"), or suggestions (e.g., "*Let's climb back up to xxx feet. I'll call ATC and let them know.*"). First officers, in contrast, most commonly provided goal or problem statements (27%), or asked the captain whether he wanted them to perform some action (14%). A third request type observed for first officers were confirmation-seeking questions (13%) such as "*Do you still want V-Ref + 15?*"

Do female and male pilots use different request types? The answer to this question is no. Our analyses indicate that status rather than gender influenced how pilots phrased requests. 35% of female captains' requests were commands and 20% were suggestions; for male captains the corresponding percentages were 39 and 18. First officers were equally similar: 29% of the female and 25% of the male first officers' requests were problem and goal statements. For permission-seeking questions the percentages were 15% for the females and 14% for the males; for confirmation-seeking questions the percentages were 13% for both groups.

Are there status and gender effects pertaining to the structure of the communications? Gender but no status differences were observed in the way pilots structured their communications. A 2 x 2 between subjects analysis of variance on number of complex responses revealed that the structure of the communications varied significantly with the gender of the respondents, $F(1,38) = 7.9$, $p < .01$), but not with their status, $F(1,38) = 1.48$, ns.; nor was there a significant gender by status interaction, $F(1,38) = 1.23$, ns.

As Table 2 shows, on average 5.3 (from a total of 8) responses by female pilots were complex, i.e., consisted of request and justifications as compared to 3.7 responses by male pilots. Since communications could either be complex or simple, this result also implies that female pilots were less likely than male pilots to state requests without also providing some justification.

TABLE 2
Mean Number of Responses Involving Request plus Justification

	FEMALE	MALE
CAPTAINS	6.00 *(1.25)*	3.70 *(2.45)*
FIRST OFFICERS	4.64 *(1.80)*	3.64 *(1.91)*

Note. Standard Deviations are given in parentheses; Total Number of Responses per Group = 8

DISCUSSION

In this study we examined what linguistic strategies pilots use when they have to challenge the actions of a colleague, and how their communications balance the need for informativeness with the need for assuring the other's cooperation.

Two strategies emerged for captains. They either gave commands or they made suggestions that referred to actions of the crew. Both strategies explicitly state what action should be taken but they differ in their social implications. Commands are direct insofar as they entail a strong obligation for the listener to comply with the speaker's request. Suggestions are less direct in this respect. However, by using the collegial "Let's do," speakers appeal to the solidarity between themselves and their listeners and seek compliance in this way. Commands, in contrast, are inherently authoritative and imply an asymmetry in status. Speakers by giving a command, express their belief that they are socially more powerful than their listeners and that they are thus licensed to command. That is, speakers seek listener compliance by appeal to their status. Status-based commands were more frequent among male captains than among female captains. Female captains instead were likely to shift the motivation for their commands away from their status to some objective necessity by referring to some problem or goal

It remains to be seen, however, how captains' strategies were affected by the severity of a problem situation. Results in a preliminary study involving only male participants, suggests that pilots increased the directness of their utterances in situations that they perceived to be risky (Fischer, 1996). Thus the observation that male captains used complex communications half of the time while female captains did so 75% of the time, could indicate that male captains were more likely than female captains to change their strategies with the severity of situations.

Both male and female first officers in this study were less direct than captains. The most common strategy of first officers was to point to some problem or to remind the captain of a given goal. What corrective action should be taken and by whom was not explicitly stated but implied and left to the captain. In their other strategies, permission-seeking and confirmation-seeking questions, first officers were more explicit about a corrective action. In the first case, they volunteered to do some course of action but left the final decision to the captain. In the latter case, they inquired or confirmed whether the captain wanted some action. Although all three strategies seek the compliance of the listener by appeal to his authority, there are important differences: By asking permission-seeking and confirmation-seeking questions, first officers specify the action for which they want the captain's compliance. Compliance, however, is not demanded but requested. By alerting to a problem or to a goal, in contrast, first officers seek the captain's compliance only with their assessment of the situation but not with a particular course of action. That is, they place the captain under no explicit obligation to initiate a corrective action but do so only indirectly by assuming that a course of action is self-evident once the problem has been acknowledged.

CONCLUSIONS

In line with previous research (Linde, 1988; Orasanu & Fischer, 1992), we found that captains are more direct in their communications than first officers. But unlike previous

work on gender differences in communication strategies (Lakoff, 1975; Tannen, 1990, 1992), we did not find that female pilots were more indirect than male pilots. In our study directness and indirectness were aligned with status not with gender. However, we did find gender differences among pilots with respect to the structure of their communications. Female pilots were more likely than male pilots to motivate their requests by referring to some objective need.

One question that our present analyses have not yet addressed concerns the relation between linguistic strategy and features of the problem situation. In particular, we need to analyze whether our participants responded differently in low-risk and high-risk situations.

REFERENCES

Blum-Kulka, S. 1987. Indirectness and politeness in requests: same or different? *Journal of Pragmatics, 11*, 131-146.

Brown, P., & Levinson, S. C. (1987). *Politeness: Some universals in language usage*. Cambridge: Cambridge University Press.

Clark, H. H. 1979. Responding to indirect speech acts. *Cognitive Psychology, 11*, 430-477.

Fischer, U (1996). *Cultural variability in crew discourse*. First year progress report. Georgia Institute of Technology.

Herrmann, T., & Grabowski, J. (1994). *Sprechen: Psychologie der Sprachproduktion*. Heidelberg: Spektrum Akademischer Verlag GmbH.

Lakoff, R. (1975). *Language and womens' place*. New York: Harper and Row.

Linde, C. (1988). The quantitative study of communicative success: Politeness and accidents in aviation discourse. *Language in Society, 17*, 375-399.

National Transportation Safety Board (1982). *Aircraft Accident Report: Air Florida, Inc., Boeing 737-222, N62AF, Collision with 14th Street Bridge, Near Washington National Airport, Washington, D. C., January 13, 1982* (NTSB-AAR-82-8). Washington, DC: Author.

Orasanu, J., & Fischer, U. (1992). Distributed cognition in the cockpit: Linguistic control of shared problem solving. In *Proceedings of the Fourteenth Annual Conference of the Cognitive Science Society* (pp. 189-194). Hillsdale, NJ: Erlbaum.

Searle, J. R. (1969). *Speech acts: An essay in the philosophy of language*. Cambridge: Cambridge University Press.

Tannen, D. (1994). *Gender and discourse*. New York: Oxford University Press.

Tannen, D. (1990). *You just don't understand: Men and women in conversation*. New York: Ballantine.

Watzlawick, P., Beavin, J., & Jackson, D. D. (1967). *Pragmatics of human communication*. New York: Norton.

Acknowledgments

We would like to thank all the pilots who volunteered to participate in this study. We are also indebted to representatives from their airlines and from ISA for all their help and support. Thanks also go to Dave Austin, Don Bryant, Barry Crane, Key Dismukes, Jerry Jones, Corwin Logdson, Jim O'Neill, Mietek Steglinski, and Barbara Sweet who helped in pretesting the material; to Michael New who helped in the design of the scenarios, and to Christina VanAken for her invaluable assistance in coding the responses.

Appendix B
German Version of the Material

LOW FACE-THREATENING SITUATIONS	
LOW-RISK	HIGH-RISK
#1 Dieser Flugabschnitt wird von Erstem Offizier Hans Fischer geflogen. Ihr Flugzeug ist in seiner Reiseflughöhe von FL 350 in VMC, als Sie feststellen, daß Ihr Flug immer noch einem Vektorkurs folgt, den die ATC Ihnen vor einiger Zeit gegeben hat. Eine Freigabe, zum ursprünglichen Flugplan zurückzukehren, ist unterblieben. Die Abweichung vom geplanten Kurs beträgt inzwischen 20 NM. Erster Offizier Fischer hat anscheinend das Problem noch nicht bemerkt.	#2 Dieser Flugabschnitt wird von Erstem Offizier Hans Fischer geflogen. Ihr Flugzeug befindet sich im Descent auf einen Flughafen, der von Bergen bis zu 8000 ft. Höhe umgeben ist. Ihr Flugzeug durchfliegt gerade 10'000 ft., als Sie feststellen, daß Ihr Flug immer noch einem Vektorkurs folgt, den die ATC Ihnen vor einiger Zeit gegeben hat. Eine Freigabe, zum ursprünglichen Flugplan zurückzu-kehren, ist unterblieben. Die Abweichung vom geplanten Kurs beträgt inzwischen 20 NM. Erster Offizier Fischer hat anscheinend das Problem noch nicht bemerkt.
#3 Ihr Flugzeug befindet sich in einer Reiseflughöhe von FL 310 in IMC, als Sie auf dem Wetterradar 25 Meilen vor Ihnen ein Gebiet mit starkem Niederschlag bemerken. Erster Offizier Ernst Huber, der das Flugzeug steuert, hält seinen gegenwärtigen Kurs mit Reisegeschwin-digkeit.	#4 Ihr Flugzeug befindet sich in einer Reiseflughöhe von FL 310 in IMC, als Sie auf dem Wetterradar 25 Meilen vor Ihnen ein Gebiet mit starkem Niederschlag bemerken. Erster Offizier Ernst Huber, der das Flugzeug steuert, hält seinen gegenwärtigen Kurs mit Reisegeschwin-digkeit, obwohl eingelagerte Gewitter in Ihrer Umgebung gemeldet wurden, und Sie auf mäßig starke Turbulenzen stoßen.
#5 Ihr Flugzeug befindet sich im Descent und durchfliegt gerade 10'000 ft. in VMC. Ihre gegenwärtige Richtung ist 360^{o}, als die ATC Ihnen, wegen Verkehrsdichte, eine Vektoränderung gibt und Sie anweist, nach rechts auf 330^{o} zu drehen. In dem Moment, in dem Karl Müller, der Erste Offizier, die Rechtskurve initiiert, meldet sich der Controller wieder und gibt zu, einen Fehler gemacht zu haben: Er möchte, daß Ihr Flugzeug nach links dreht. Erster Offizier Müller hat diese Berichtigung anscheinend nicht gehört und setzt die Rechtskurve fort.	#6 Ihr Flug hat die Starterlaubnis erhalten. Flugzeuge, die vor Ihnen gestartet waren, meldeten Gewitter rechts der Abflugroute. Auf 1500 ft. Höhe, kurz nach Ihrem Takeoff von Startbahn 36, weist Sie Departure Control an, nach rechts auf 330^{o} zu drehen. In dem Moment, in dem Karl Müller, der Erste Offizier, die Rechtskurve initiiert, meldet sich der Controller wieder und gibt zu, einen Fehler gemacht zu haben: Er möchte, daß Ihr Flugzeug nach links dreht. Erster Offizier Müller hat diese Berichtigung anscheinend nicht gehört und setzt die Rechtskurve fort.
#7 Erster Offizier Martin Weber steuert das Flugzeug. Unterwegs, als sich Ihr Flug-zeug in Reiseflughöhe befindet, fragt Sie die ATC nach Ihrer Estimated Time für den Waypoint Charlie, eine Position, die nicht in Ihrem Flugplan vorkommt. In diesem Moment wird Ihnen klar, daß Sie beide eine frühere Clearance mißver-standen haben, und daß Ihre Kursab-weichung bereits mehrere Meilen beträgt.	#8 Erster Offizier Martin Weber steuert das Flugzeug. Sie befinden sich im Descent auf einen Flughafen, der von Bergen bis zu 10'000 ft. Höhe umgeben ist. Wetter-bedingungen sind IMC. Als Sie 12'000 ft. durchfliegen, fragt Sie die ATC nach Ihrer Estimated Time für den Waypoint Charlie, eine Position, die nicht in Ihrem Flugplan vorkommt. In diesem Moment wird Ihnen klar, daß Sie beide eine frühere Clearance mißverstanden haben, und daß Ihre Kursabweichung bereits mehrere Meilen beträgt.

HIGH FACE-THREATENING SITUATIONS	
LOW-RISK	HIGH-RISK
#11 Erster Offizier Arno Schmidt steuert das Flugzeug. Nach dem Start weist Sie Departure Control an, auf 9000 ft. zu steigen und diese Höhe bis auf weiteres zu halten. In 8500 ft. Höhe teilt man Ihnen mit, daß sich anderer Flugverkehr 60° links von Ihnen auf 12'000 ft. Höhe im Steigflug befindet. Nachdem Sie das andere Flug-zeug ausgemacht haben, überschauen Sie Ihre Bordinstrumente und bemerken, daß Erster Offizier Schmidt 9200 ft. durch-fliegt mit einer Steigungsrate von 1200 ft./min.	#12 Erster Offizier Arno Schmidt steuert das Flugzeug. Nach dem Start weist Sie Departure Control an, auf 9000 ft. zu steigen und diese Höhe bis auf weiteres zu halten. In 8500 ft. Höhe teilt man Ihnen mit, daß sich anderer Flugverkehr leicht links von Ihnen auf 12'000 ft. Höhe befindet. Nachdem Sie das andere Flug-zeug ausgemacht haben, überschauen Sie Ihre Bordinstrumente und bemerken, daß Erster Offizier Schmidt 9800 ft. durch-fliegt mit einer Steigungsrate von 2800 ft./min.
#13 Sie sind auf einem Langstreckenflug unter VMC. Ihr Flugzeug befindet sich in Reiseflughöhe, als Sie bemerken, daß der Autopilot unregelmäßig arbeitet, und daß Erster Offizier Peter Zimmer, der Pilot-Flying, eingeschlafen ist.	#14 Sie sind auf einem Langstreckenflug unter IMC. Flugzeuge vor Ihnen meldeten mäßige Vereisung während dem Descent. Kurz vor Top of Descent bemerken Sie, daß der Autopilot unregelmäßig arbeitet, und daß Erster Offizier Peter Zimmer, der Pilot-Flying, eingeschlafen ist.
#15 Während des Anflugs auf Ihren Ziel-flughafen meldet der Controller Regen-schauer und berichtet, daß das Flugzeug 5 Meilen vor Ihnen kurz vor der Landung in mäßig starke Turbulenzen geraten ist. In 1000 ft. Höhe bemerken Sie, daß Erster Offizier Paul Kröger mit normaler Approach Speed fliegt, obwohl Sie während des Briefings beschlossen hatten, den Anflug mit einer um 15 kts erhöhten Geschwindigkeit durchzuführen	#16 Während des Anflugs auf Ihren Ziel-flughafen berichtet der Controller, daß das Flugzeug 5 Meilen vor Ihnen eine Wind-shear durchflogen hat und kurz vor der Landung 10 kts an Airspeed verloren hat. Außerdem meldet man ein Gewitter, das sich 15 Meilen hinter dem Ende der Landebahn befindet. In 500 ft. Höhe bemerken Sie, daß Erster Offizier Paul Kröger mit normaler Approach Speed fliegt, obwohl Sie während des Briefings beschlossen hatten, den Anflug mit einer um 15 kts erhöhten Geschwindigkeit durchzuführen.
#17 Sie fliegen in VMC Ihren Zielflughafen mit zwei Parallelpisten an. Der Controller weist Sie an, den Localizer der linken Landebahn aufzunehmen und ihm zu folgen. Er macht Sie auch darauf aufmerksam, daß parallele Anflüge auf die rechte Landebahn durchgeführt werden. Sie bemerken, daß Erster Offizier Oskar Walter 1 dot links vom Kurs fliegt und die Abweichung nicht ausgleicht.	#18 Sie fliegen in IMC Ihren Zielflughafen mit zwei Parallelpisten an. Der Controller weist Sie an, den Localizer der rechten Landebahn aufzunehmen und ihm zu folgen. Er macht Sie auch darauf aufmerksam, daß parallele Anflüge auf die linke Landebahn durchgeführt werden. Sie bemerken, daß Erster Offizier Oskar Walter 1 1/2 dots links vom Kurs fliegt und auf den Approach Korridor der angrenzenden Landebahn zusteuert.

Fragen zu den Situationen

(1) Inwieweit ist der Erste Offizier (für die Kursabweichung) verantwortlich?
(2) Wie riskant in bezug auf die Flugsicherheit ist die beschriebene Situation?
(3) Wenn Sie der Flugkapitän in dieser Situation wären, inwiefern wäre es Ihne unangenehm, dem Ersten Offizier zu sagen, (er müsse seinen Kurs berichtigen)?
(4) Inwiefern ist die beschriebene Situation für den Ersten Offizier peinlich?
(5) Wie viel Zeit verbleibt, auf die beschriebene Situation zu reagieren?