

*Paper presented at the Human Factors of Decision Making in Complex Systems conference, Dunblane, Great Britain, Sept. 8 – 11, 2003.*

## **Why Do Airline Pilots Take Risks? Some Insights From A Think-Aloud Study**

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## ABSTRACT

The present research examined commercial airline pilots' responses to risk and the factors that influence their decisions. Participants were asked to verbalize their concerns and reasoning while deciding on how to proceed in two hypothetical decision situations. Across both situations, the strongest predictor of pilots' decisions was their assessment of the safety risk. Corporate differences were found in pilots' use of risk mitigation strategies and decision consistency across situations.

## KEYWORDS

Naturalistic decision making, risk assessment and management, decision errors

## INTRODUCTION

Safe flight depends on effective decision making. While decision errors are relatively infrequent in everyday flight, they tend to be the most consequential compared to other types of errors (3, 4). Many of these errors reflect decisions of the crew to continue with a plan of action despite the presence of cues suggesting that their original plan should be modified (= plan continuation errors) (6).

Why do pilots sometimes continue with a flight as planned even though this course of action carries a considerable safety risk? The traditional answer to this question is that people's preference for risk-seeking reflects their decision frame (7). According to behavioral decision research, people tend to be risk-seeking if available options are framed in terms of losses. Specifically, people are willing to take a gamble if it entails a possibility of no loss (e.g., "no one may die") rather than accept a moderate but sure loss (e.g., "1/3 will die"). On the other hand, if the same options are framed as gains, people typically prefer the moderate but sure gain ("2/3 will be saved") to the gamble ("everybody may be saved"), called "risk averse."

While behavioral decision research stresses the evaluation of decision outcomes in risky choices, alternative approaches to decision making in real world contexts emphasize the role of situation assessment and perceived control in people's decisions (2, 1). Unlike subjects in traditional laboratory studies, decision makers in the real world have to notice some potential threat requiring their attention, gather information that they consider relevant, and decide how best to control the risk. Accordingly, pilots' plan continuation errors may result from inappropriate risk assessment or inadequate actions to control the risk.

Moreover, pilots' risk assessment and subsequent decisions are not only influenced by individual cognitive factors, but also by organizational pressures relating to company productivity, economics, and safety culture. In a risk survey, pilots indicated that decision difficulty was associated with situations that pit safety against economic considerations (5). Resolving this kind of goal conflict is cognitively taxing and may render pilots' risk assessment and management vulnerable to error.

## METHOD

### Material

Two hypothetical decision scenarios were created involving decision dilemmas aggravated by ambiguous conditions and uncertain outcomes. In both scenarios, continuing with the original plan posed a threat to flight safety. However, if the original plan were successful, it would also bring economic and productivity gains. On the other hand, changing the original plan would increase the margin of safety, but would also incur economic or other losses.

One scenario presented a decision dilemma at takeoff: to continue with takeoff although there was a possibility of windshear, or to go to the end of a long line of waiting aircraft and delay departure even more (the flight had already been delayed). The second scenario involved a decision during approach to the destination airport on Christmas Eve: bad weather delayed the approach and a curfew was looming at the destination airport. Risks in this situation included productivity (getting passengers where they wanted to go on an important holiday), safety (possible fuel exhaustion), and economic (accommodating passengers on later flights).

### Design and procedure

Thirty pilots from each a major, and a national U.S. carrier participated in the research, with equal numbers of captains and first officers.

Both scenarios consisted of an unfolding sequence of events reflecting progress over time. At each point in time, pilots could ask for more information than was presented in the initial event description, such as the current radar image. In the study with the major carrier, experimental material was printed on flash cards and handed to the pilots. The study with the national carrier involved computer presentation of the material. Participants in both studies were asked to think aloud about their concerns and reasoning while they decided on how to proceed at each point in the evolving event. Sessions were audiotaped and later transcribed for content analysis.

## RESULTS

### Pilots' decisions

In the Takeoff Scenario most of the pilots (73%) indicated that they would take off although there was a chance of windshear, thus choosing the riskier option in terms of safety. In contrast, slightly more pilots in the Approach Scenario (57%) favored the safer course of action and chose to divert to their alternate.

### Factors influencing pilots' decisions

Hierarchical log-linear analyses indicated that pilots' decisions in the two scenarios did not differ by crew position or airline. However, an airline effect was observed in pilots' use of mitigation strategies and decision consistency. Pilots from the major carrier who selected the riskier course of action were more likely than their colleagues from the national carrier to take precautionary steps such as full power on takeoff to reduce the effect of possible windshear (94% of pilots from the major versus 67%

from the national carrier), or requesting priority handling on approach to reduce the likelihood of fuel exhaustion (80% of major versus 27% of national). Pilots from the two carriers also differed with respect to decision consistency on the two scenarios (consistently risk-avoiding or risk-taking vs. inconsistent). While decision consistency was low for pilots from the major carrier (41%), it was considerably higher for pilots from the national carrier (63%), especially for risk-taking decisions (19% and 51% for the major and national carrier, respectively).

Content analyses of the think-aloud protocols were conducted to determine whether pilots who chose risk-avoiding options were concerned with different issues than pilots who chose riskier options. Protocols were segmented into idea units (corresponding to a verb and its grammatical arguments) and coded in terms of their content. Interrater reliability was 90%. In both scenarios safety clearly dominated pilots' thinking, irrespective of their final decision. In the Takeoff Scenario, all pilots discussed extensively the approaching weather and the reported airspeed loss (55% of their total talk). Similarly, in the Approach Scenario much of the talk concerned fuel status and destination weather (38% by risk-taking and 42% by risk-avoiding pilots). Logistic regression analyses revealed no significant differences between risk-taking and risk-avoiding pilots in the proportion of talk devoted to safety issues, nor were there any consistent differences in their talk of economic pressures. However, in both scenarios differences were found in the extent to which pilots discussed available options. Pilots who decided to delay departure talked more frequently about this option than pilots who chose to take off; the latter, in turn, talked more about issues associated with departure such as checklists and takeoff speeds. Pilots who ultimately chose to continue the flight in the Approach Scenario talked more about landing at their destination and the curfew than pilots who decided to divert.

Further analyses examined whether pilots who made riskier decisions treated relevant issues and information in the scenarios differently than pilots who made risk-avoiding decisions. To determine this, the pilots' think-aloud protocols were coded in terms of *how* they processed the information in addition to *what* they talked about. We coded whether they requested additional information about a particular topic (e.g., weather), reviewed or monitored its status, evaluated it positively or negatively, recognized it as a goal or condition, made plans for it, or initiated an action or decision about it. Inter-coder reliability for these functional codes was 88%. Logistic regression analyses identified pilots' evaluations as the strongest predictor of their final decisions. In both scenarios, pilots who took the riskier option made more positive statements about the situation than pilots who avoided the risk. Across scenarios 14.6% of the utterances by risk-takers were positive remarks, in contrast to 6.6% of the utterances by risk-avoiding pilots. In the Approach Scenario pilots who decided to continue with the approach expressed more optimism about the weather conditions, the likelihood of landing at their original destination, and making the curfew than pilots who decided to divert. In the Takeoff Scenario

those who decided to take off evaluated the weather and airspeed loss more positively than did those who delayed the departure.

## DISCUSSION AND CONCLUSIONS

These findings suggest that faulty risk assessment rather than inappropriate action decisions or decision frames may be a dominant factor in plan continuation errors. Pilots in the dynamic decision task were risk-taking or risk-avoiding depending on their assessment of the situation. If their decisions only reflected more or less confidence in their ability to control the perceived risk, we would not expect to observe differences in their risk assessment.

Differences between pilots in their evaluation of threats relating to safety apparently resulted from the ambiguity of the problem cues and uncertainty concerning outcomes. While pilots in the Approach Scenario who continued with the approach talked more about the curfew than those who diverted, they talked just as much about the weather and fuel situation as their more cautious colleagues, albeit in a more optimistic manner. In a similar vein, pilots who continued in the Takeoff Scenario did not show any greater concern with external pressures than those who delayed the departure, but their talk about safety related issues was more positive. Economic pressures, such as the schedule delay or long line of planes behind them were hardly mentioned by pilots in the Takeoff Scenario, no matter what their final decision. Instead, pilots based their decisions on different interpretations of the same weather cues. If they considered the threat to flight safety to be serious, they took a cautious approach and adopted a new course of action. On the other hand, if they painted a less negative picture, they continued with their original plan, frequently taking actions to mitigate the risk. In both situations, pilots' normative model was to "go" (or continue) unless something occurred that surpassed a subjective threshold of safety. This kind of thinking is most vividly illustrated in statements such as "Nothing has come up that would make me decide not to make the departure."

While our analyses did not reveal any differences between pilots from the two carriers in their decision processes, we did observe some differences in their decision patterns. Pilots from the major carrier seemed to be more responsive to the specifics of a situation because their risk tolerance varied across the scenarios. In contrast, pilots from the national carrier were more likely to choose consistently risk avoiding or risk tolerant options (more often the latter) across the different scenarios. In addition, they were less likely than their colleagues from the major carrier to mitigate the safety risk associated with riskier decisions. Our data do not provide a basis for determining the source of these differences. They may be due to differences between carriers in kind and amount of operational experience of their pilots, corporate climate, pilot selection procedures, or training practices. Also we cannot rule out the potential effect of the task administration mode (paper cards vs. computer-based). Further studies will explore these differences.

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