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Understanding How Pilots Make Weather-Related Decisions

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The decision-making strategies of pilots were examined using a linear modeling technique. Three hundred twenty-six American, 104 Norwegian, and 51 Australian pilots completed a scenario-based judgment task in which they assigned a comfort rating to each of 27 weather scenarios for each of three routes. These data were then used to develop individual regression equations, for each pilot, that described the information combination process used to assign the comfort ratings. The results demonstrate the use of a consistent weather decision model among pilots in these diverse groups. Intercorrelations of mean comfort levels for the 27 scenarios were very high, and each group demonstrated a similar pattern of information use. For each group, the compensatory models of information utilization were favored over noncompensatory models. The results suggest that pilots share a common model for the use of weather information and that training interventions may be equally effective across countries.

According to an extensive analysis of weather-related accidents conducted by the Aircraft Owners and Pilots Association (1996), inefficient or ineffective in-flight

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weather-related decision making remains a significant causal factor associated with general aviation fatalities in the United States. Typically, these fatalities were associated with aircraft accidents in which pilots continued flight into instrument meteorological conditions (IMC) despite the fact that they were only authorized to fly under visual flight rules (VFR). Colloquially referred to as VFR-into-IMC accidents, they account for 10% of the overall number of crashes involving general aviation operations. However, 82% of these accidents involved fatalities. The aim of this study was to examine how pilots utilize information regarding weather conditions to assess the suitability for a flight, using pilots from three geographically diverse countries. Ultimately, a better understanding of how pilots make weather-related decisions can lead to better training strategies that will reduce weather-related accidents.

WEATHER-RELATED DECISION MAKING

The nature of the general aviation environment is such that pilots are expected to operate in an uncertain and risky operational domain where they are confronted with a range of meteorological phenomena about which a series of in-flight decisions need to be made. The information pertaining to these decisions is complex and is obtained from a range of sources, including meteorological briefings, in-flight weather reports, visual information from the cockpit, and on-site reports. In each case, pilots are expected to integrate this information and formulate an expectation of the nature of the conditions that are likely to be present at a given location and time. The dynamic nature of the aviation environment is such that the meteorological conditions may change rapidly and generally require a continuous reappraisal and reinterpretation of the information available.

Jensen (1992) suggests that effective and efficient decision making in the aeronautical environment involves both a motivational component and a cognitive component. In the case of the former, there is an assumption that poor decision making is due, in part, to an inappropriate motivation to continue a flight in the face of deteriorating conditions (Murray, 1999). Anecdotal evidence arising from aircraft accidents has been used to provide support for this perspective, particularly in cases where there is evidence to suggest that a pilot was under some level of extraneous pressure to reach a destination (Harris, 1994). Indeed, the Federal Aviation Administration sponsored a number of initiatives to redress the motivational component of aeronautical decision making, the majority of which focused on the principle of “hazardous thoughts” (Adams & Thompson, 1987, 1988; Lester & Bombaci, 1984; Lester, Diehl, & Buch, 1985).

The “hazardous thoughts” approach to the management of aeronautical decision making was based on an analysis of aircraft accidents in which five classes of errors were observed in terms of pilots’ motivation to continue a flight. These errors were designated as follows: invulnerability, macho, external control, antiauthority, and impulsivity (Lester et al., 1985). A sixth hazardous thought (deference) was identified subsequently by Telfer (1988) in a validation of the hazardous thoughts model in Australia. The aim of the hazardous thoughts approach was to assist pilots in identifying an underlying predisposition toward a particular hazardous thought and apply remedies within the operational environment (Holt et al., 1991).

In contrast to the motivational component, the cognitive component of aeronautical decision making has only relatively recently been the subject of detailed analyses. However, differences between experts and novices confirm that the cognitive aspect of decision making may be as significant as the motivational component in facilitating effective and efficient in-flight weather-related decisions. For example, Wiggins and O'Hare (1995) compared the information acquisition strategies of expert and novice pilots and noted that experts were significantly more efficient than novices in terms of the acquisition and integration of information during simulated in-flight weather-related decision making. It might be argued that these differences reflect a superior level of knowledge representation among experts in comparison to novices. Evidence to support this assumption can be derived from an analysis of expert and novice decision making conducted by Barnett (1989) in which measures of knowledge representation were most prevalent among the predictors of expert performance during a series of decision-making scenarios.

CHARACTERIZING AERONAUTICAL DECISION MAKING

Although differences have been noted between expert and novice decision-makers at a number of levels, the difficulty associated with the cognitive approach to aeronautical decision making has been the limited evidence concerning the process through which pilots integrate task-related information to effect a decision. For example, Rockwell and McCoy (1988) examined the in-flight decision-making performance of "low time" pilots and noted a series of errors, including the failure to obtain trend-type weather information, the failure to obtain information relating to alternate airports, and the failure to develop a global representation of the conditions. However, explaining why these errors occur is difficult in the absence of an understanding of the process by which pilots acquire and integrate this information.

Layton and McCoy (1989) attempted to develop an understanding of pilot decision making by asking pilots to "think aloud" as they made a series of simulated in-flight weather-related decisions. The results suggested that the information of most concern to pilots pertained to the cloud ceiling and the visibility. Moreover, the verbal protocols appeared to indicate that participants were primarily concerned with avoiding areas of poor weather rather than seeking areas in which good weather was evident.

In a more detailed analysis of the process of information integration, Flathers, Giffin, and Rockwell (1982) asked pilots to rate 16 airports on the basis of air traffic control services, airport weather conditions, the time to reach the airport, and the availability of instrument approach facilities. The airports were rated from "least preferable" to "most preferable" and a worth function was calculated for each participant across each dimension. The results suggested that, in comparison to pilots with an air transport license, private and commercial pilots assigned a relatively greater worth function to weather information and the time to reach the airport.

Further elaborating the approach taken by Flathers et al. (1982), Driskill et al. (1997) asked pilots to rank a series of 27 weather scenarios that differed according to the terrain, precipitation, visibility, and the cloud ceiling. Pilots were also asked to rate their level of comfort for each scenario, and these ratings were used to classify the classes of cognitive strategies that pilots used to integrate and compare the information available. Specifically, Driskill et al. (1997) sought to determine whether pilots were adopting a compensatory or noncompensatory strategy during the assessment of the various options.

A compensatory decision-making strategy involves a consideration of the positive and negative attributes of each option and the selection of that option with the greatest number of positive attributes (Vining & Fishwick, 1991). This approach is consistent with more analytical decision-making strategies such as Subject Expected Utility Theory, in which each option is evaluated simultaneously (Heath & Tversky, 1990). In contrast, a noncompensatory approach involves an assessment of each option against a predetermined criterion. An option is selected only if it reaches criterion on every one of the attributes. This approach tends to be more consistent with naturalistic decision strategies such as Recognition-Primed Decision-Making, in which a serial evaluation of options is conducted (Klein, 1993).

Because the present study used the scenarios and benchmark values developed by Driskill et al. (1997) and the technical report may not be available to many readers, we describe their study in some detail. As a first step, Driskill et al. developed standardized benchmark values for various levels of each attribute (i.e., precipitation, visibility, and ceiling). Specifically, a group of 22 very experienced pilots (mean flight time = 3700 hr), 16 of whom were certified flight instructors, rated the safety of various levels of ceiling, visibility, and precipitation with respect to visual flight rules (VFR) flight by a pilot with 500 hr of flying experience.

These 22 pilots provided safety ratings for 8 levels of precipitation (ranging from no precipitation to freezing rain), 12 levels of visibility (ranging from .5 nautical mile to more than 8 nautical miles), and 16 levels of ceiling (ranging from 600 to 5000 ft). The obtained ratings were standardized to $M = 5.0$ and $SD = 1.0$ and are shown in Table 1. Interrater agreement (R_{11}) for the three attributes were .88, .92, and .92, for precipitation, visibility, and ceiling, respectively.

TABLE 1
Standardized Benchmark Values

Variable	*Benchmark value*	*Level*
Precipitation		
None	6.745	High
Light rain	6.000	High
Light snow	5.514	Medium
Moderate rain	5.205	Medium
Moderate snow	4.687	Medium
Heavy rain	4.287	Low
Heavy snow	3.975	Low
Freezing rain	3.589	Low
Visibility (in nautical miles)		
More than 8	6.598	High
8	6.410	High
7	6.165	High
5	5.446	Medium
4	4.939	Medium
3	4.639	Medium
1½	3.960	Low
1	3.896	Low
½	3.822	Low
Ceiling (in feet)		
5000	6.419	High
4000	6.244	High
3500	6.081	High
2000	5.383	Medium
1800	5.010	Medium
1600	4.702	Medium
900	3.928	Low
800	3.818	Low
600	3.664	Low

Source: Driskill et al. (1997, Table 2).

Sets of High, Medium, and Low values (as indicated in Table 1) were then identified by inspection for each variable. Three sets of 27 weather scenarios were then generated (one set for each terrain type). Scenario sets were initially generated such that each scenario within a set was unique with respect to precipitation, visibility, and ceiling level combination (e.g., High/High/High and High/High/Medium). Within level, however, selection of the specific value was randomized (i.e., selection of 5000, 4000, or 3500 ft within the high level of the ceiling variable was randomized). A group of 12 weather subject matter experts then reviewed the scenarios and those that were considered to be improbable combinations of the three variables were replaced.

These 81 scenarios were printed on cards and were given to 152 pilots in group settings of up to 25 pilots in a group. After reading instructions and completing a brief set of biographical questions, pilots sorted, separately, each of the three sets of 27 scenarios in order from least comfortable to most comfortable about completing the flight. Next, the pilots were asked to assign a 0-to-100 comfort rating to each scenario, in which 0 represented least comfortable about completing the flight and 100 was most comfortable about completing the flight.

Using the comfort ratings, Driskill et al. (1997) computed regression equations for each pilot, individually, in which the dependent variable was the rating of comfort level assigned to each scenario and the predictor variables were the benchmark values for the three weather attributes for that scenario. Regression equations were developed for "typical" compensatory and noncompensatory models of decision making, and these models were compared to determine the extent to which participants were using compensatory or noncompensatory strategies. The results suggested that pilots tended to adopt a model that was more consistent with a compensatory approach and that this effect occurred irrespective of experience. More importantly, the application of a compensatory approach was relatively consistent, irrespective of the terrain over which the scenario was flown.

The initial research by Driskill et al. (1997) was conducted using scenarios situated within the United States and with a relatively small sample of pilots drawn from central Texas. The aim of the present study was to determine whether the results obtained by Driskill et al. would be observed among pilots drawn from a larger, multinational sample of pilots. Specifically, it was hypothesized that a common compensatory decision strategy would be evident among pilots from three geographically and socially disparate countries (the United States, Norway, and Australia).

METHOD

Participants

In each of the three countries, pilots were recruited for this study by somewhat different means. In the United States, 3000 pilots' names and addresses were randomly drawn from a commercially available database (Avantext) that approximates the population of pilots in that country. All these pilots were sent a copy of the test booklet with an invitation to participate in the study; 326 returned completed booklets.

In Norway, a similar procedure was used. A roster of 500 pilots' names and addresses were obtained from the Norwegian Civil Aviation Authority and a postcard inviting the pilots to participate was sent to all the pilots on the roster. Those pilots (218) who responded favorably to the postcard were then sent a copy of the booklet, and 104 pilots completed and returned the booklet.

In Australia, pilots were recruited through a random sampling of pilots enrolled in an undergraduate university program. The booklet was mailed to 400 pilots, and 51 pilots completed and returned the Australian version of the booklet.

Although the participants were invited to participate via a mailing and completed the booklets at home, these samples were not intended and should not be construed as statistical probability samples. That is, this was not a survey in the usual sense of that term, as would be the case when researchers attempt to estimate the extent of some characteristic of the underlying population within a specified confidence interval. Rather, like almost all samples used in the behavioral sciences, these are self-selected samples of convenience, chosen to differ on the variable of interest—nationality.

Instrument Development

Following the method described by Driskill et al. (1997), this research employed a scenario-based judgment task designed to elicit pilot worth functions (a worth function is simply the linear combination of predictor variables) for visibility, ceiling, precipitation, and terrain variables. Examples of three such scenarios are given in Table 2.

The routes and scenario combinations used by Driskill et al. (1997) were used for the American data collection. Equivalent routes (in terms of terrain type and length) were created for both Norway and Australia, depicting flights over large bodies of water, mountainous, and nonmountainous areas. Scenarios were given in the same order for each of the three national groups. The principal differences among the test instruments were that the Norwegian instrument was translated into Norwegian and the Australian instrument used “Dust” in place of those scenarios that used “Snow.” This exchange was necessitated because of the lack of experience of Australian pilots with “Snow” conditions. We elected to take this approach in order to maintain consistency and parallel data collection forms across the three samples. However, since these two weather conditions may not have been strictly equivalent, a post hoc analysis was planned to evaluate the impact of this substitution.

TABLE 2
Weather Scenarios

Scenario number	*Ceiling (feet)*	*Visibility (miles)*	*Precipitation*	*Rank order*[a]	*Comfort level*[a]
210	1800	4	None		
216	5000	1.5	Moderate rain		
223	1600	0.5	Moderate snow		

[a]Data provided by subjects.

Procedure

Subjects were instructed to rank-order separately the 27 weather scenarios for each terrain route and then to assign a comfort level to each scenario. Comfort level ranged from 1 (*highest comfort*) to 100 (*lowest comfort*). This scale orientation was reversed from that used by Driskill et al. (1997), based on comments received from participants in the earlier study. Comfort level was operationally defined for the participants as the level of comfort that they would have in flying under the specified conditions along the specified route. Because a mail-out procedure was used, the data collection instruments differed somewhat from the Driskill et al. procedure, which used a group data collection. In the present study, all weather scenarios and response blocks for a given route were printed on a single sheet, whereas Driskill et al. used individual cards for each weather scenario.

RESULTS

Comparison of Three Pilot Samples

Comparisons among the three pilot samples on age, recent experience, and total experience (as shown in Table 3) were conducted using ANOVA. An ANOVA of

TABLE 3
Characteristics of Pilot Samples

	Percentage of Occurrence						
	United States (N = 326)		*Norway (N = 104)*		*Australia (N = 51)*		
Private	34		41		4		
Commercial	46		59		35		
Airline transport	21		—[a]		61		
Instrument rated	79		60		82		
Multiengine rated	52		55		96		
Employed as pilot	20		51		74		
Flight instructor	36		21		42		
Aircraft owner	54		22		8		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*
Age	52	12	40	10	33	10	81.53*
Recent experience[b]	36	56	74	69	119	83	44.48*
Total experience[c]	3891	5710	4051	4874	5107	4328	1.04

[a]The Airline Transport certificate is not used in Norway. [b]Flying hours in previous 90 days. [c]Total of all flying hours accumulated.
*$p < .001$.

Age showed an overall significant main effect of nationality, $F(2, 466) = 81.53$, $p < .001$. Post hoc comparisons, using Bonferroni, showed that all the paired comparisons were significant ($p < .001$). The ANOVA for Recent Experience also showed an overall significant effect of nationality, $F(2, 465) = 44.48$, $p < .001$. Post Hoc comparisons, using Bonferroni were significant ($p < .001$) for all the paired comparisons. ANOVA for Total Experience yielded a non-significant main effect of nationality, $F(2, 458) = 1.04$, $p = .353$. Differences in licensing structure among the three groups precludes comparison using, for example, chi-square, to examine the distribution of pilot certificates. For the other ratings, the differences are so evident that calculation of a statistical index is hardly necessary.

Comfort Level

Comfort level ratings were chosen as the measure of interest for analysis, instead of rank orderings, because the former measure more closely approximated an interval scale. Rank order information, on the other hand, must by its nature be an ordinal scale. Table 4 contains the overall mean comfort levels, averaged across all 27 weather scenarios, for each of the three terrain conditions and each pilot sample. Statistical comparisons of the mean comfort levels are not presented, since they are irrelevant to the hypothesis under consideration and there was no a priori expectation that the mean comfort levels would be equal.

Intercorrelation of the mean comfort levels among the three samples are of interest, however, as they indicate the commonality of the ranking of the scenarios among the three groups. These intercorrelations (shown in Table 5) are very high between the United States and Norway and only somewhat less for the other combinations. This indicates that, regardless of the absolute level of comfort assigned, there is very high agreement among the three samples of pilots on the relative ranking of the various scenarios.

TABLE 4
Mean Comfort Levels for Each Pilot Sample and Route

	United States (N = 326)		*Norway (N = 104)*		*Australia (N = 51)*	
	M	*SD*	*M*	*SD*	*M*	*SD*
Over water	60	22	54	25	56	22
Over flat land	58	22	56	26	50	24
Over mountains	63	22	62	25	57	24

Note. Lower scores indicate a higher degree of comfort with a route (1 = *most comfortable* and 100 = *least comfortable*).

TABLE 5
Intercorrelation of Mean Comfort Levels

	United States	*Norway*	*Australia*
United States	—	.98	.91
Norway	.98	—	.89
Australia	.91	.89	—

Note. All correlations significant, $p < .01$.

TABLE 6
Mean R^2 for Each Route and Pilot Sample

	United States	*Norway*	*Australia*
Route 1—Over water	.67	.64	.69
Route 2—Nonmountainous	.72	.74	.82
Route 3—Mountainous	.80	.81	.82

Note. All correlations significant, $p < .01$.

Worth Function Analysis

To examine how pilots combine weather information to arrive at a comfort determination, worth functions were created for each pilot by terrain type using the following regression equation:

$$\mathrm{CF} = C + V + P + \mathrm{CV} + \mathrm{CP} + \mathrm{VP} + \mathrm{CVP},$$

where CF was a vector of a pilot's 27 weather scenario comfort ratings for a given type of terrain and C, V, and P and their interactions were vectors of benchmark values for ceiling, visibility, and precipitation, respectively. The regression equations represent a pilot's worth function with respect to the given terrain type. A total of 1443 regression equations were computed (one for each pilot for each terrain type). The benchmark values were those reported by Driskill et al. (1997) based on rankings assigned to the various parameter values by subject matter experts (i.e., highly experienced pilots and flight instructors) and reproduced here as Table 1.

The mean R^2 for each route for each of the three samples is given in Table 6. The values were generally high and demonstrate that most of the variance in the pilots' comfort level assignments was associated with the three variables being manipulated.

Decision Models

The pilots' use of weather information was further evaluated by examining the individual worth functions for the presence of two model types: compensatory and noncompensatory. To evaluate the use of compensatory models, additive, multiplicative, and worst-factor models were created. The additive model summed the three benchmark factors and implied equal weights for the three factors. The multiplicative model, both two- and three-factor models, cross-multiplied benchmark values. This model implies a policy in which high levels of one or more factors compensate for low levels of the other factors. The worst factor cutoff model used the lowest of the three benchmark values. This model implies a policy in which the poorest of the three factors controlled the comfort evaluation decision.

The noncompensatory models were explored using continuous single factors as the decision variable and single-factor cutoffs. The continuous single-factor models represent a pilot using only a single continuous factor to make the comfort assessment. A pilot who made the comfort assessment based on one of the factors exceeding some critical value would be represented by the cutoff models. Since the benchmark values were scaled with a mean of 5.0, that value was chosen as the cutoff point.

Table 7 gives the correlations between the mean comfort levels and the decision model vectors. To maximize power, the data from all three routes were combined; however, similar results were obtained when the routes were examined separately.

TABLE 7
Correlation of Mean Comfort Levels with Decision Model Vectors

Decision Models	*United States (N = 326)*	*Norway (N = 104)*	*Australia (N = 51)*
Noncompensatory			
Ceiling (C)	.49	.40	.52
Visibility (V)	.56	.61	.63
Precipitation (P)	.58	.54	.54
Ceiling > 5.0	.50	.43	.53
Visibility > 5.0	.49	.52	.54
Precipitation > 5.0	.58	.54	.56
Compensatory			
Sum of CVP	.85	.81	.88
CVP Product	.89	.84	.91
CV Product	.75	.72	.82
CP Product	.74	.65	.73
VP Product	.74	.75	.76
Worst Factor (C, V, or P)	.40	.35	.39

Note. All correlations significant, $p < .01$.

Equivalence of "Snow" and "Dust" Conditions

As noted earlier, the Australian version of the data collection form used "Dust" in place of "Snow" in the scenarios. To evaluate the equivalence of this exchange, we examined the pattern of results among the three samples for scenarios in which snow (or dust) did and did not appear. The Australian pattern differed somewhat from the United States and Norway, which were very similar, suggesting that the two conditions may not have been equivalent. An ANOVA was then conducted, using the mean comfort level for the 81 scenarios as the dependent variable, and the snow–dust versus no-snow–dust condition as the independent variable. None of the differences between the snow–dust and no-snow–dust conditions were statistically significant, but the pattern again suggested that the United States and Norway were more similar than was Australia. This suggests that the Australian pilots did not regard dust in the same way that the American and Norwegian pilots regarded snow. Specifically, it is possible that dust was not perceived as being as hazardous as snow.

This implies that the benchmark values may have overestimated the severity of that factor for the Australian sample. This would have the effect of attenuating the individual multiple correlations computed for each participant. However, since the obtained multiple correlations from all three samples were high, we conclude that the effects of this discrepancy were not large and did not substantially influence the conclusions drawn from the analyses.

DISCUSSION

In this study, we evaluated the hypothesis that pilots from diverse geographic settings use a common compensatory decision strategy in making their weather-related decisions. To address this hypothesis, the Driskill et al. (1997) methodology was modified to permit the use of a mail-out booklet to a large international sample of pilots. The data obtained from those pilots were then used to construct individual regression equations which expressed the model that each pilot used in making the decisions posed in the weather scenarios. Consistent with the Driskill et al. (1997) study, we found that we were able to construct regression equations that accounted for the majority of the variance in the pilots' ratings.

Examination of these individual regression equations allowed us to evaluate the extent to which the pilots utilized compensatory and noncompensatory models. Again, consistent with the Driskill et al. (1997) study, pilots were clearly found to utilize the compensatory models in preference to the noncompensatory models. Comparisons among the results across the three pilot samples also clearly demonstrated that the pilots from these three geographically diverse areas all shared a common preference for compensatory weather decision models. However, there are five aspects of the current study that limit the generalizability of these results.

First, the nature of the study and the data collected necessitated a design in which only a paper representation of a hypothetical flight could be presented. Whether similar results would be obtained in actual flight conditions cannot be determined from the present study. It may well be that the present results, produced without time-stress demands, are characteristic of preflight decision making, while time-stressed, in-flight decisions are better described by noncompensatory models, as characterized by Recognition Primed Decision-Making (Klein, 1993).

Second, in order to maximize experimental control, we elected to limit the amount of information provided to pilots to those elements that we manipulated—specifically, ceiling, visibility, precipitation, and terrain. We cannot say, therefore, whether other aspects of a flight (for example, type of aircraft, fuel reserve, or time of day) might also have entered into the individual regression equations and altered the decision models.

Third, although the United States, Norway, and Australia represent geographically diverse segments of the aviation community, they all share a fairly similar, Western European cultural tradition. Pilots from a more culturally diverse segment might present different outcomes.

Fourth, since the pilots in two of the three groups were self-selected from randomly drawn samples of pilots, sampling error may have influenced the distribution of pilot demographic variables in ways that cannot be determined from the present data.

Fifth, the use of "Dust" in place of "Snow" in the Australian data collection instruments may have resulted in the creation of scenarios that were not strictly equivalent to those used in the United States and Norway.

With these potential limits to generalizability in mind, the finding that pilots from all three locations used the same compensatory decision model as the preferred weather information utilization models has implications both for safety and for training. From the safety perspective, while compensatory decision models are an efficient use of information, in the sense that they combine all information sources simultaneously, their use by inexperienced pilots may place them at greater risk of being in a weather-related accident. For example, the use of a compensatory weather model means that a pilot might decide that conditions are suitable for flight when the ceiling is high (a safe situation), but the visibility is low (an unsafe situation), since the high ceiling compensates for the low visibility in the global evaluation of the situation. Flight under such conditions by the inexperienced pilot who lacks the training required for sustained flight solely by reference to the aircraft instruments will place the pilot at considerable risk of an accident. Simply put, having a high ceiling does not compensate for the fact that the pilot cannot see where he or she is going.

In contrast, noncompensatory decision models provide for much better control of the risk factors influencing a flight. In one noncompensatory model, typically referred to as the multiple-hurdle model, each aspect of the situation is individually examined and compared to a criterion, and a decision to initiate a flight is only made if all the factors individually meet their respective criteria. In the example given above, a pilot would first compare the ceiling to the ceiling criterion and, if that test is passed, then compare the visibility to the visibility criterion. Only if all the tests were passed would the pilot initiate a flight. The fact that one of the factors, say ceiling, vastly exceeded the criterion value, would not be used to lower the criterion for visibility.

With respect to training, these results suggest that interventions designed to improve safety developed in one setting could be used, perhaps with equal impact, in many settings. Training materials from Australia and Canada are now being modified for use in the United States and Australian authorities have adapted and adopted the Personal Minimums Checklist training for use in Australia, where the program has been well received. The Personal Minimums Checklist was developed by Jensen and his associates (Jensen, Guilkey, & Hunter, 1998; Kirkbride, Jensen, Chubb, & Hunter, 1996) to address the issue of proceduralizing the decision-making process to ensure that pilots established and adhered to personal standards in weather and other areas. This type of training encourages pilots to use noncompensatory decision models by establishing, for example, a minimum personal standard of 3000 ft (1000 m) as the criterion for ceiling and a minimum visibility of 4 mi (6.5 km). Before each flight, a pilot verifies that each aspect of the flight met their personal standards. The use of the Personal Minimums Checklist may reduce the instance of compensatory decision model use among inexperienced pilots. However, the impact of this approach has yet to be evaluated fully.

Perhaps more than most occupations, piloting is an activity that transcends national borders and global regions. The activities, roles, and expectations of pilots are, to a large extent, the same regardless of where they exercise their skills. This study has demonstrated that compensatory models are the preferred method of making weather-related decisions by pilots. Moreover, within the western culture at least, this preference seems to be shared by pilots in very diverse locations. The common problems faced by pilots lead to the use of common decision models and, ultimately, may be addressed with common solutions.

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