The Role of Situation Assessment and Flight Experience in Pilots' Decisions to Continue Visual Flight Rules Flight into Adverse Weather

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Visual flight rules (VFR) flight into instrument meteorological conditions (IMC) is a major safety hazard in general aviation. In this study we examined pilots' decisions to continue or divert from a VFR flight into IMC during a dynamic simulation of a cross-country flight. Pilots encountered IMC either early or later into the flight, and the amount of time and distance pilots flew into the adverse weather prior to diverting was recorded. Results revealed that pilots who encountered the deteriorating weather earlier in the flight flew longer into the weather prior to diverting and had more optimistic estimates of weather conditions than did pilots who encountered the deteriorating weather later in the flight. Both the time and distance traveled into the weather prior to diverting were negatively correlated with pilots' previous flight experience. These findings suggest that VFR flight into IMC may be attributable, at least in part, to poor situation assessment and experience rather than to motivational judgment that induces risk-taking behavior as more time and effort are invested in a flight. Actual or potential applications of this research include the design of interventions that focus on improving weather evaluation skills in addition to addressing risk-taking attitudes.

INTRODUCTION

In an analysis of general aviation (GA) accidents between 1990 and 1997, Goh and Wiegmann (2001a) found that the fatality rate in accidents involving visual flight rules (VFR) flight into instrument meteorological conditions (IMC), or unqualified flight into adverse weather, was consistently higher than that of other GA accidents. The fatality rate for accidents related to VFR flight into IMC was approximately 80% during this period, compared with about 19% for other types of GA accidents. These statistics reflect similar trends found by the National Transportation Safety Board (NTSB, 1989) for U.S. GA accidents that occurred during the 1970s and mid-1980s, as well as GA accident trends in other countries (e.g., United Kingdom and New Zealand). Together these findings clearly indicate that VFR flight into IMC is a major safety hazard in general aviation (O'Hare & Smitheram, 1995).

VFR flight into IMC is often characterized by pilots' decisions to continue a flight into adverse weather conditions despite having been given information or presented with cues indicating they should do otherwise (NTSB, 1989). This continuation of one's original plan, even with the availability of new evidence suggesting that the plan should be abandoned, has been termed a *plan continuation event* (PCE; Orasanu, Martin, & Davison, 2001). In circumstances when the identified events are

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considered errors, PCE also stands for *plan continuation error.*

Plan Continuation Errors

Burian, Orasanu, and Hitt (2000) analyzed 276 aviation incident reports that involved weather events and found that 28% of the 333 identified decision events were considered to be plan continuation errors. The commission of PCEs in these cases was very strongly related to violations of the rules as defined by Reason (1990). In other words, the continuation of a flight into adverse weather was often found to be a willful disregard for the regulations and cues that dictated an alternative and safer course of action. According to the authors, these violations reflect a growing commitment to a chosen course of action, or a tendency to adhere to an original plan, which ultimately interfered with pilots' critical analysis and ability to evaluate the feasibility of the chosen plan over time.

A similar explanation for VFR flight into IMC focuses on predictions made by prospect theory (Kahneman & Tversky, 1982). For example, O'Hare and his colleagues (O'Hare & Owen, 1999; O'Hare & Smitheram, 1995) investigated how pilots frame the situation of continuing or discontinuing a flight into adverse weather. In essence, their hypothesis predicts that pilots who frame diverting from the planned flight as a loss (e.g., loss of time, money, and effort) will tend to continue with the flight, whereas those who frame the diversion as a gain (e.g., in personal safety) will tend to divert. Indeed, O'Hare and Smitheram (1995) found that during a simulated VFR cross-country flight, pilots who were presented with adverse weather information that focused on the gains of diverting were less likely to continue the flight than did pilots who were presented the same weather information that focused on the losses associated with diverting.

O'Hare and Smitheram (1995) suggested that in a real flight environment, decision frames may be induced by the proximity of the pilot's goal, such as the destination airport. As goal achievement gets closer, there may be a natural shift from the gains to the loss frame, resulting in what is known in prospect theory as the *sunk-cost effect.* Specifically, if more has been invested in a certain course of action, it is less likely that this course of action will be abandoned than if less were invested (Kahneman & Tversky, 1982). O'Hare and Owen (1999) formally tested this hypothesis by requiring pilots to fly a simulated cross-country flight in which they encountered adverse weather either early or late into the flight. The prediction was that pilots who encountered the weather late into the flight (long condition) would be more likely to continue because of the greater investment of time, compared with those who encountered the weather earlier during the flight (short condition). However, the results of the study failed to support the sunk-cost hypothesis. The majority of pilots in both conditions chose to divert the flight.

O'Hare and Owen (1999) suggested that the lack of support for the sunk-cost effect in their experiment could have been attributable to several methodological issues rather than to an invalidity of the hypothesis. In particular, the primary measure of pilots' decision-making processes was their decision to either continue or divert the flight by the time they had reached a particular point in the flight. The pilots in their study were then considered to have chosen either to continue or to divert the flight. However, this dichotomous classification of the pilots' decisions may not have been sensitive enough to detect differences in the way pilots viewed the situation and their subsequent decision. Rather, a better measure might have been to assess the amount of time or distance that the pilots had flown into the weather prior to diverting, allowing a greater variability in pilots' responses. Indeed, most VFR pilots will probably decide to divert from adverse weather; however, some decide too late and ultimately crash. Thus the *amount of time* that pilots take to choose to divert a VFR flight into an IMC might better capture the natural processes by which these decisions are made in real-life situations.

Situation Assessment Errors

In contrast to the PCE or sunk-cost hypothesis, Goh and Wiegmann (2001b) suggested that VFR flight into IMC might be better explained in terms of errors in situation assessment. According to the situation assessment hypothesis, pilots risk pressing on into deteriorating weather because they do not fully realize they are doing so. In other words, pilots continue VFR flight into IMC when they misdiagnose the changes in or severity of the weather. Presumably had they known that the weather was deteriorating into IMC, they would not have flown into it. For example, in an empirical investigation of this issue, Goh and Wiegmann (2001b) found that pilots who chose to continue with a simulated cross-country flight into adverse weather conditions had less accurate assessments of visibility than did those who chose to divert. In addition, Goh and Wiegmann's (2001a) analysis of accident records from the NTSB accident database showed that between 1990 and 1997, a quarter of the accidents related to VFR flight into IMC clearly involved inadvertent encounters with adverse weather. Therefore, at least in some cases, VFR flight into IMC might be better viewed as a failure of recognition-primed decision making (Klein, 1993) rather than a willful disregard of the rules and regulations.

The loss of situation awareness that precipitates a VFR into IMC event, however, may be caused by a variety of factors, the most important of which is likely to be the lack of experience in interpreting real-time weather by low-time or "fair weather" pilots. The importance of experience in problem diagnosis is central to Klein's (1993) *recognition-primed decision making* (RPD) model. According to the RPD model, experience or expertise allows an individual to diagnose a situation quickly, thereby immediately identifying a feasible course of action. Experience also allows the individual to overcome the effects of time pressure because there is little need to compare the feasibility of different action alternatives. Indeed, experienced pilots tend to be better at identifying critical situations as well as estimating the time available to evaluate problems and initiate actions (Jentsch, Bowers, & Salas, 1999; Orasanu, McDonnell, & Davison, 1999). Furthermore, Burian et al. (2000) found that pilots in their study who were in the 25th percentile and below in terms of total flight hours were more likely to commit PCEs than were those in the 75th percentile and above. They took those findings to suggest that some pilots, particularly those with less experience, "do not trust what their eyes are telling them and so proceed on blindly" (p. 25).

The situation assessment hypothesis suggests that pilots' experiences are a key factor in predicting VFR flight into IMC. Specifically, pilots with more experience should be better able to properly diagnose adverse weather, and therefore decide to divert sooner, than pilots with less experience. Furthermore, the situation assessment hypothesis might reasonably predict a weather location effect opposite that predicted by the sunk-cost hypothesis. Because pilots generally receive a weather briefing prior to departure, encountering unexpected adverse weather early in a flight would directly contradict their mental model of the current weather system. Therefore, such pilots may be more prone to "go take a look" to update their situation assessment, given their confusion about the weather and the fact that the departure airport provides a safe haven immediately behind them (McCoy & Mikunas, 2000). In contrast, on long flights, initial weather information becomes relatively old and unreliable, but pilots have the opportunity to update their mental model of the weather using their senses and flight instruments. Perhaps with an experientially based model of the situation and no immediate safe haven behind them, such pilots are more reluctant to press on into adverse weather and therefore decide to divert more quickly.

Objectives and Hypotheses

The purpose of the present study was to further examine these issues by studying pilots' decisions to continue or divert from a VFR flight into IMC during a dynamic simulation of a cross-country flight. During the flight, general aviation pilots encountered IMC either early or later into the flight, and the amount of time and distance pilots flew into the adverse weather prior to diverting was recorded. According to the sunk-cost hypothesis, pilots who encounter adverse weather later during the flight should continue flying into the weather longer than those who encounter the weather early during the flight, given that the former have invested more time and effort into the flight. However, the sunk-cost hypothesis makes no predictions about the relationship between pilots' prior flight experiences and their flight into the adverse weather. In contrast, the situation assessment hypothesis suggests that when adverse weather is encountered early in a flight, pilots may be more prone to "go take a look" or fly longer into the adverse weather in an attempt to reconcile the disparity between the encountered weather and the weather information recently obtained prior to departure (McCoy & Mikunas, 2000). In addition, the situation assessment hypothesis predicts that pilots with more experience should be better able to diagnose adverse weather and should therefore decide to divert the flight sooner than those with less experience.

METHOD

Participants

Thirty-six private pilots (35 men, 1 woman) from central Illinois participated in this study. Participants were recruited in a manner to ensure a broad range of flight experience. Their total flight hours ranged from 63 to 1983 hr (*Mdn* = 236.1 hr) and they had completed between 4 and 550 (*Mdn* = 45) cross-country flights at the time of the study. Twenty-five of the pilots were instrument rated. Participants' ages ranged from 18 to 62 years (*Mdn* = 43.5 years). All were compensated $20 for their participation, which did not exceed 2 hr.

Materials and Procedure

At the onset of the study, participants signed a consent form and then completed a pre-experimental questionnaire. This questionnaire required participants to provide demographic and background information including age, sex, total flight hours (dual and solo), total VFR hours, total instrument flight rules (IFR) hours (simulated and actual), total hours of cross-country flight, total number of cross-country flights (dual and solo), and total number of hours flown in the last 30 and 90 days. After completing this questionnaire, participants read a set of instructions that described the simulated flight scenario. The instructions explained that they were going to make two VFR cross-country flights, the first of which was a practice flight from Champaign to Terre Haute in order to familiarize themselves with the simulator. In the second experimental flight they were to fly from Champaign to Rochelle, which was approximately 120 nautical miles (NM). Participants were told to imagine making this solo cross-country flight for the purpose of logging flight time.

We introduced participants to the Frasca 142 flight simulator, which was configured as a Cessna 172. The simulator had a full set of instruments and a radio stack. All the necessary controls (yoke, rudder pedals, throttle) were also available. An Evans and Sutherland SPX 2400 visual system was used to project a 135° view of the outside visual world. This system was capable of displaying real-time weather changes and three-dimensional fixes along the flight route. After the practice flight (approximately 20 min), the participants were provided with a checklist, map, and flight plan, which detailed the route and the fixes along the route. They were given terminal aerodrome forecasts, an aviation routine weather report (METARS), and winds-aloft information for the day of the flight. They were told that the weather observations were taken at 7:30 a.m. that day and were good until 7:30 a.m. the next day. The weather conditions at takeoff were above VFR minimums: 5 statute miles (sm) visibility and 5000-foot Mean Sea Level (MSL) cloud ceiling. Winds were forecast to be from the northwest (310) at 8 knots with a 20% chance of rain later that evening. Participants were given as much time as they needed to review the weather information and other flight-planning details.

We instructed the pilots to treat the flight the same as any that they would make in the real world. They were told that they were responsible for monitoring aircraft systems for possible failures and for scanning for other possible traffic or changes in the weather. They were also informed that these problems might not necessarily occur. However, in the event that they did decide to divert from the planned flight, we informed them that they could choose any alternative airport that was on the map, including the departure airport. They were instructed to inform the experimenter if and when they decided to deviate from the original flight plan and to press a predetermined key on the simulator to mark the point in the flight at which this decision was made.

Prior to the experimental flight, pilots were assigned to either a short group (n = 18), in which degrading weather occurred early after departure, or a long group (n = 18), in which degrading weather occurred later during the flight. To ensure that groups did not differ in experience levels, participants were matched individually across groups on factors such as total flight time, flight time in the last 30 and 90 days, instrument rating, and total instrument flight time. As a result, participants in these treatment groups did not differ significantly on any of these experience factors.

For participants in the short group, weather conditions degraded to IMC, reaching 2 sm visibility and 1500 foot MSL cloud ceiling approximately 30 NM into the flight (approximately 15 min from the departure airport). For participants in the long group, weather conditions decreased to 2 sm visibility and 1500 foot MSL cloud ceiling approximately 90 NM into the flight, which was roughly 30 NM or 15 min from the destination airport. For both groups, the deterioration of weather conditions (lowering of cloud ceiling and reduction in visibility) occurred when pilots were at straight and level flight. Weather degraded gradually and at the same rate for both groups, beginning roughly 15 NM from the point at which conditions would be at their worst.

Note that because the destination airport did not have the facilities capable of supporting an instrument approach, pilots could not transition to an IFR flight plan into the destination airport. Both groups had a relatively large airport available as a diversion point at approximately equal distances (roughly 15 min away) from the point at which the weather began to degrade. Participants were allowed to continue the flight until they either decided to divert the flight to an alternative airport or "crashed" the airplane.

Following the flight simulation, participants completed a postexperimental questionnaire in which they assessed the weather conditions in terms of visibility and cloud ceiling at the time the program was terminated. Then the pilots were compensated, thanked for their participation, and dismissed.

RESULTS

Effects of Weather Location

Time and distance flown into deteriorating weather. For analysis purposes, the point along the pilots' flight path at which the simulated cloud ceiling dropped to 4000 foot MSL and visibility degraded to 4 sm was designated the location at which pilots had encountered degrading weather. The time and distance that pilots in both the short and long groups traveled beyond this point were collected. All 36 pilots in this study continued flight past the point at which the weather began to degrade. Of these, 35 pilots ultimately diverted. One pilot in the short group lost control of the airplane while continuing flight into the adverse weather and "crashed."

The overall distance and time that pilots flew into the adverse weather conditions varied considerably. In general, the distance pilots traveled into the weather ranged from 0.91 NM to 13.32 NM (Mdn = 4.74 NM). The amount of time traveled into the weather ranged from 0.45 to 5.8 min (Mdn = 2.49 min). Given that these values were widely dispersed, as were values on other measures such as flight experience, a nonparametric approach was used throughout this study to increase statistical power (Conover, 1999).

Results of Mann-Whitney U tests revealed that pilots in the short condition traveled significantly farther (Mdn = 5.94 vs. 2.75 NM), $U(18, 18) = 76$, $p < .01$, and longer into the deteriorating weather (Mdn = 2.86 vs. 1.48 min), $U(18, 18) = 91$, $p < .05$, than did those in the long condition. (These differences remained even when the data from the pilot in the short group who crashed were excluded from the analysis.) As a result, the severity of the weather that pilots in the short condition ultimately encountered was generally worse. In particular, the cloud ceiling eventually encountered was significantly lower for pilots in the short condition (Mdn = 2614.5 feet MSL) than for those in the long condition (Mdn = 3359 feet MSL), $U(18, 18) = 75.5$, $p < .01$. This was also true for visibility: short Mdn = 2.96 sm versus long Mdn = 3.59 sm, $U(18, 18) = 75.5$, $p < .01$.

Situation assessment. The accuracy of pilots' situation assessment was computed by subtracting actual weather parameters (i.e., visibility and cloud ceiling) from pilots' estimates at the time they chose to divert the flight or, in the case of the pilot who crashed, at the time of the accident. Based on these assessments, pilots were considered to be underestimators (UEs), accurate estimators (AEs), or overestimators (OEs) for both the visibility and cloud ceiling variables. For the visibility variable, participants were considered UEs if their estimates were more than 1 sm below actual visibility conditions, AEs if their estimates were within ±1 sm of actual conditions, or OEs if their estimates were greater than 1 sm above actual visibility conditions. For the cloud ceiling variable, participants were considered UEs if their estimates were more than 200 feet below actual cloud ceilings, AEs if their estimates were within ±200 feet of actual ceilings, or OEs if their estimates were greater than 200 feet above actual cloud ceilings.

Overall, approximately one third of the pilots accurately estimated visibility and cloud ceiling (35.3% for visibility and 33.3% for cloud ceiling). A relatively equal proportion of pilots either overestimated visibility (26.5%) and cloud ceilings (25%) or underestimated visibility (38.2%) and cloud conditions (41.7%). A chi-square analysis revealed that the weather-location manipulation had little effect on pilots' estimates of visibility. A relatively equal proportion of pilots in both the short and long flight conditions either accurately estimated (38.9% vs. 31.3%) or underestimated (44.4% vs. 31.3%) visibility. However, weather location did appear to have a significant effect on estimates of cloud ceilings, $\chi^2(2, N = 36) = 8.511, p < .05$. Specifically, cloud ceiling was accurately estimated by a significantly larger proportion of pilots in the long condition (50%) than in the short condition (16.7%). Furthermore, cloud ceiling height was overestimated by a larger proportion of pilots in the short flight condition (44.4%) than in the long condition (5.6%), whereas a relatively equal portion of pilots in both the long (44.4%) and short conditions (38.9%) underestimated cloud ceilings.

The Role of Flight Experience

Time and distance flown into deteriorating weather. Table 1 displays Spearman rank-order correlations between flight experience variables (total flight hours, total solo hours, actual IFR hours, total VFR cross-country hours, and hours in the last 30 and 90 days) and the distance and time that pilots traveled into the deteriorating weather. As can be seen from the table, all flight experience variables were negatively correlated with both time and distance flown into the weather, indicating that the less experience or flight hours pilots had, the farther and longer they tended to travel into the weather. The experience variables with the largest negative correlations were those that

TABLE 1: Spearman Rank-Order Correlations between Flight Experience Variables and the Amount of Time and Distance Pilots Continued Flying into Deteriorating Weather

	Total Hours	Solo Hours	Actual IFR Hours	Total VFR Cross-Country Hours	Hours in Past 30 Days	Hours in Past 90 Days
Combined						
Distance	–.181	–.226	–.287	–.167	–.372*	–.384*
Time	–.147	–.195	–.260	–.120	–.450**	–.462**
Short Group						
Distance	–.170	–.292	–.185	–.020	–.367	–.292
Time	–.205	–.300	–.330	–.065	–.387	–.317
Long Group						
Distance	–.333	–.404	–.311	–.510*	–.658**	–.603**
Time	–.224	–.289	–.155	–.338	–.740**	–.675**

*$p < .05$, **$p < .01$.

involved recent flight experience (i.e., hours logged in the previous 30 and 90 days).

These correlations, however, differed across experimental groups. In the short condition no significant relationships were observed between any of the flight experience variables and the amount of time and distance pilots had flown into the weather, albeit the direction of the relationships were still negative. In contrast, the negative correlations between recent flight experience during the previous 30 and 90 days were stronger and highly significant for pilots in the long condition. Furthermore, a significant negative correlation was also observed between total VFR cross-country flight hours and the distance that pilots in the long condition flew into the adverse weather during the experiment.

Experience and situation assessment. Analyses were performed to assess possible differences in the flight experience variables across different levels of situation assessment accuracy. In general, participants who underestimated visibility and cloud ceilings (i.e., were more conservative in their estimates) tended to have more overall flight hours than did those who accurately estimated or overestimated these parameters. However, median tests indicated that these differences were not significant and did not vary consistently across the short and long experimental conditions.

DISCUSSION

The results of the present experiment suggest that the location at which adverse weather is encountered during a flight does affect pilots' decisions to continue with the flight. Specifically, pilots who encountered the deteriorating weather conditions earlier in the flight flew longer into the weather prior to diverting than did pilots who encountered the deteriorating weather conditions later in the flight. This finding contradicts the sunk-cost hypothesis that pilots will be more likely to continue VFR flight into IMC as more time and effort has been invested in the flight. This finding also challenges conventional wisdom in the aviation field that VFR flight into IMC is attributable simply to motivational judgment processes such as "get-thereitis" (Jensen, 1995).

The results of the present study are more in line with the situation assessment hypothesis (Goh & Wiegmann, 2001b). It is possible that pilots who encountered adverse weather early in a flight were more prone to "go take a look" or fly longer into the adverse weather in an attempt to reconcile the disparity between the encountered weather and the weather information obtained just prior to departure. This explanation is supported by the finding that pilots who encountered the adverse weather early in the fight were more likely to overestimate (to believe the clouds were higher than they were) than were pilots who encountered the weather later in the flight. Presumably pilots in this latter group knew that the weather information they received prior to departure had become old and possibly unreliable. They were therefore more likely to trust their senses when interpreting the weather than were pilots who encountered the weather early during the flight.

Another possibility, however, is that the observed differences in situation assessments between pilots in the short and long conditions were attributable to more implicit perceptual processes (i.e., adaptation levels and change detection) than to explicit cognitive processes or mental model reconciliation (i.e., "go take a look"). Specifically, for the short group, cloud ceiling and visibility conditions started to change almost immediately after departure, whereas for the long group, the same weather changes began after a long "baseline" of steady weather conditions. Perhaps it was easier for pilots to notice the change in the weather after they had been exposed to a long period of stable weather, which then suddenly changed, than it was for pilots in the short group, who experienced relatively continuous changes in weather following departure. Indeed, there is evidence from psychophysical research that sudden changes from so-called normal are generally easier to detect than are similar changes in a continually changing visual array (Dember & Warm, 1979). Additional research is needed, however, to determine whether the rate at which adverse weather conditions change actually does affect pilots' situation assessments.

Pilots' previous flight experiences influenced how long they continued flight into the adverse weather prior to diverting. In particular, the more experienced pilots tended to divert sooner than did the less experienced pilots. This relationship was generally stronger when the adverse weather was encountered later in the flight, possibly because the changes in the weather in the short condition did occur relatively quickly. The relationship between experience and weather-related decision making has also been observed previously. For example, Goh and Wiegmann (2001a) found that pilots involved in accidents caused by VFR into IMC had fewer total flight hours and lower pilot certifications than did pilots involved in other types of accidents. However, in the present study the number of flight hours in the previous 30 and 90 days were found to be the most relevant experience variables, suggesting that recency of experience may be as important as total experience in some cases.

The exact role that experience plays in affecting pilots' decisions about whether to continue or divert VFR flight into IMC is still unclear. One obvious role is that experience improves pilots' abilities to evaluate changing weather conditions. Indeed, according to the situation assessment hypothesis, pilots with more experience should be better able to diagnosis adverse weather and should therefore decide to divert the flight sooner compared with those with less experience. However, in the present study no discernable relationship was found between pilots' flight experience and their estimates of visibility and cloud ceilings. One possibility for the lack of any observable relationship may be that verbal and written reports of weather conditions are simply not sensitive enough to discriminate between differences that exist across experience levels. Furthermore, differences in pilots' abilities to estimate weather conditions across experience levels may be limited to the extreme ends of the distributions. For example, Burian et al. (2000) needed to compare pilots in the 25th percentile and below in terms of flight hours with those in the 75th percentile and above in order to find differences in the likelihood of committing plan continuation events. Clearly more research is needed to explore the roles that different experience factors play in pilots' aeronautical decision-making processes.

Finally, as with all laboratory and simulator studies, the external validity of the experiment and the generalizability of the findings need to be addressed. Indeed, one issue of concern is that of pilots' perceptions of risk. No risks are involved in flying a simulator, so it therefore is not the same as actual flight into adverse weather. Consequently, there is always the possibility that pilots may not take the simulated flight seriously and may thus exhibit risk-taking behaviors that would not normally occur in the aircraft. In the present study we tried to encourage pilots to treat the simulation as they would an actual fight, and results revealed that pilots did not exhibit a proclivity for pressing on into the deteriorating weather, suggesting that they were considering the risks of VFR flight into an IMC. It is possible, however, that the pilots exhibited more cautious behavior than they normally would in the airplane because they were trying to impress the experimenter with their good judgment. In either case, enough variability in pilots' behavior was observed to allow us to detect significant difference across experience levels and treatment conditions. Whether such differences are actually larger or smaller in the real world is unclear.

A second important issue related to external validity is that of the match between the simulated flight scenario and real-world flying conditions. In the present study some pilots encountered changes in weather very soon after departing from the airport. The extent to which pilots would ever actually encounter such conditions, however, is difficult to determine. The primary sources of such information are naturalistic databases that come from accident and incident reports. Unfortunately, such data sources are often incomplete and contain scant data pertaining to the actual weather locations and conditions associated with these events. Nonetheless, examples do exist in which pilots, either knowingly or unwittingly, have taken off into adverse weather conditions (Goh & Wiegmann, 2001b). However, no single scenario can match all the weather conditions that pilots may encounter during flight. Research is therefore needed to explore the impact that different scenarios have on pilots' decision-making processes.

CONCLUSION

VFR flight into IMC is a major safety hazard in general aviation. The purpose of the present study was to empirically examine how the location of the weather along the flight path affects pilots' decisions either to continue a flight into adverse weather or to divert. The findings suggest that under these conditions, VFR flight into IMC may be attributable in part to poor situation assessment and experience rather than to motivational factors and risk-taking behaviors that increase with time and effort invested in the flight. Interventions should therefore focus on improving weather evaluation skills in addition to addressing risk-taking attitudes. One example would be the Weatherwise computer-based training program recently developed for the Federal Aviation Administration by Wiggins and O'Hare (draft year 2001); this program uses static images and short video clips to help pilots practice identifying critical weather cues. Initial evaluations of this program have shown positive effects on aeronautical decision making. Clearly, such effective interventions can be developed only through empirical research and a deeper understanding of naturalistic decision-making processes.

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