DOT/FAA/AM-95/1

Office of Aviation Medicine
Washington, D.C. 20591

A Review of Civil Aviation Fatal Accidents in Which "Lost/Disoriented" Was a Cause/Factor: 1981-1990

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January 1995

Final Report

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U.S. Department of Transportation
Federal Aviation Administration

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A REVIEW OF CIVIL AVIATION FATAL ACCIDENTS IN WHICH "LOST/DISORIENTED" WAS A CAUSE/FACTOR: 1981-1990

Introduction

The National Transportation Safety Board (NTSB) analyzes circumstances and data from civil aviation accidents and ascribes one or more causes and/or related factors to help explain each accident. Among the formally accepted NTSB categories of accident findings is one termed "lost/disoriented;" that term refers to a loss of geographic awareness and, perhaps, resulting confusion on the part of the pilot. It differs from "spatial disorientation" which refers to a false perception of distance, attitude, or motion relative to the plane of the earth's surface when a correct perception is necessary for controlling position, attitude, or motion (6). The present study was undertaken to provide information regarding the circumstances surrounding fatal general aviation accidents attributed to "lost/disoriented" conditions in recent years, and to define some demographic and behavioral characteristics of the "lost/disoriented" pilot.

Methods

Special requests were made to the National Transportation Safety Board (NTSB) for computer printouts of report briefs of all lost/disoriented accidents from 1981 through 1990. Although there have been changes in format and content over time, these briefs each contain certain standard information regarding aviation accidents (e.g., statement of cause, nature of injuries, etc.). Those reports were examined and analyzed in terms of type of accident, age and experience of pilots, actions of pilots, night or day, weather, and other conditions.

Results

Tabulations over the 10-year period (1981-1990) yielded a total of 120 accidents in which "lost/disoriented" was among the findings noted by investigators of fatal general aviation accidents (see Table 1). In all but 7 cases, the finding that the "pilot became lost/

TABLE 1. Fatal Lost/Disoriented General Aviation Accidents by Cause/Factor and Type of Injury

	Attribution			Injuries (Fatal, Serious/Minor)			
				Pilots		Passengers	
Year	Cause	Factor	Finding Only	Fatal	S/M	Fatal	S/M
1981	12	0	0	11	1	14	0
1982	6	4	0	9	1*	10	0
1983	14	5	0	19	0	18	1
1984	10	2	1	12	1	14	1
1985	13	8	1	22	1*	20	0
1986	11	6	0	16	1	15	2
1987	7	5	0	13	0	19	0
1988	6	3	0	9	0	7	1
1989	0	0	3	3	0	3	1
1990	0	1	2	3	0	3	0
Totals	79	34	7	117	5	123	6

* = Minor

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TABLE 2. Fatal Lost/Disoriented General Aviation Accidents, 1981-90, by Time (Day vs. Night) and Weather (Instrument vs. Visual Meteorological Conditions) and the Number of Instrument Rated Pilots Involved

Year	Fatal Accidents	Time		Weather		Instrument Rated Pilots
		Day	Night	IMC	VMC	
1981	12	5	7	5	7	0
1982	10	5	5	6	4	3
1983	19	11	8	11	8	2
1984	13	7	6	10	3	4
1985	22	14	8	13	9	7
1986	17	3	14	9	8	9
1987	12	7	5	5	7	5
1988	9	3	6	7	2	5
1989	3	0	3	2	1	0
1990	3	1	2	2	1	2
Totals	120	56	64	70	50	30

TABLE 3. Fatal Lost/Disoriented General Aviation Accidents in Which Flight into Instrument Meteorological Conditions (IMC) Was Also a Cause/Factor

Year	Fatal Accidents	Flight Into IMC		
		Initiated	Continued	Inadvertent
1981	12	2	3	0
1982	10	3	4	1
1983	19	7	2	2
1984	13	6	2	0
1985	22	7	2	1
1986	17	5	4	2
1987	12	2	3	2
1988	9	5	1	0
1989	3	0	1	0
1990	3	0	1	1
Totals	120	37	23	9

TABLE 4. The Involvement of Pilots With and Without Instrument Ratings in Fatal Lost/Disoriented General Aviation Accidents Involving Visual vs. Instrument Meteorological Conditions

Instrument Rating	No. Pilots	Accident Condition		Findings: IMC Conditions		
		VMC	IMC	Initiated	Continued	Inadvertent
Yes	30	12	18	7	2	1
No	90	38	52	30	21	8
Totals	120	50	70	37	23	9

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TABLE 5. Age Groupings of Pilots in Fatal Lost/Disoriented General Aviation Accidents, 1981-90

	Age (in years)						
Year	<25	25-34	35-44	45-54	55-64	65+	Totals
1981	3	1	5	2	1	0	12
1982	0	3	2	1	2	2	10
1983	1	2	5	8	2	1	19
1984	0	5	3	3	2	0	13
1985	1	6	6	4	5	0	22
1986	1	4	6	3	3	0	17
1987	0	1	2	4	4	1	12
1988	0	2	2	2	1	2	9
1989	0	0	1	0	1	1	3
1990	0	0	0	2	0	1	3
Totals	6	24	32	29	21	8	120

disoriented" was later cited as one of the causes or factors in the resulting accident. Two of the 7 exceptions included a case (1984) in which the accident was attributed to pilot incapacitation due to carbon monoxide exposure and a case (1985) in which the aircraft broke up in flight; both cases were retained in the tabulations. Also retained were the 5 other exceptions (all occurred in 1989 and 1990); for these cases, the NTSB "causes" were listed but "factors" were not.

Of the remaining 113 cases, "lost/disoriented" was considered one of the causes of 79 of the accidents and as one of the factors in the remaining 34 cases. The 120 accidents, each of which resulted in at least one fatality, yielded a total of 240 deaths (117 pilots and 123 passengers), 9 serious injuries, and 2 minor injuries.

Just over half of the 120 accidents (53.3%) occurred at night (Table 2); and 58.3% of all accidents were associated with instrument meteorological conditions (IMC), but only 25% of the pilots had instrument ratings. Although 70 of the accidents were designated as having occurred in IMC, various types of inclement weather (including haze) were present in 77 cases; in 3 other accidents, low ceilings (twice) and heavy clouds with turbulence were noted. All of the latter 3 occurred in daytime accidents along with 10 cases each of rain and of snow, 9 of fog, 3 of haze, and 9 accidents with combinations of those conditions. Of the 64 nighttime accidents, fog was present in 10, rain in 6, snow in 4, haze in 1, and various combinations of inclement weather in 15 cases. Where weather was not an issue in nighttime accidents, only 1 case noted a "bright night;" all 27 others noted a "dark night."

That pilots initiated, continued, or inadvertently encountered flight into IMC was cited in 68 of the case reports (Table 3). However, the influence of these conditions is understated; for example, in some cases, instrument rated pilots who initiated flights into inclement weather were not cited for that condition but, rather, for poor planning/decisions. Table 4 shows the involvement of instrument rated and noninstrument rated pilots in visual meteorological conditions (VMC) and IMC and the number of cases that cited inadvertent or intentional flight into IMC. Interestingly, the proportions of accidents for the two pilot groups in VMC and in IMC are almost identical to the ratio of instrument to noninstrument rated pilots in the study (i.e., about 3:1). A major difference is in the contribution to the accident of inadvertent encounters with unfavorable weather - 8 of those 9 cases involved noninstrument rated pilots. Moreover, over five times as many noninstrument rated vs. instrument rated pilots were cited for initiating or continuing flight into IMC.

The age of pilots involved in lost/disoriented fatal accidents ranged from 17-78 years. A distribution of accidents by age categories (Table 5) indicates very

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TABLE 6. Total Flying Time Logged by Pilots in Fatal Lost/Disoriented General Aviation Accidents, 1981-90

Year	Total Hours Logged Flying Time <100	100-199	200-499	500+	?	Totals
1981	4	3	3	2	0	12
1982	0	4	0	5	1	10
1983	3	3	5	6	2	19
1984	2	3	1	6	1	13
1985	2	2	6	12	0	22
1986	3	5	2	5	2	17
1987	0	2	1	9	0	12
1988	0	1	2	6	0	9
1989	0	0	1	2	0	3
1990	0	0	1	2	0	3
Totals	14	23	22	55	6	120

TABLE 7. Total Hours in Aircraft Type Logged by Pilots in Fatal Lost/Disoriented General Aviation Accidents, 1981-90

Year	Total Hours in Type <25	25-49	50-99	100+	?	Totals
1981	3	4	2	3	0	12
1982	0	2	1	3	4	10
1983	4	1	2	4	8	19
1984	2	2	3	5	1	13
1985	2	1	4	9	6	22
1986	2	1	4	3	7	17
1987	1	0	2	4	5	12
1988	0	0	0	6	3	9
1989	1	0	1	0	1	3
1990	0	0	0	2	1	3
Totals	15	11	19	39	36	120

TABLE 8. Categories of Pilot Certificates and Altered States of Pilots Involved in Fatal Lost/Disoriented General Aviation Accidents, 1981-90

Year	Fatal Accidents	Other Than Private Pilots ATP	Commercial	Student	Pilots in Altered States
1981	12	0	1	1	1 (Cocaine, Amyl Nitrite)
1982	10	0	1	0	1 (Alcohol)
1983	19	0	1	1	2 (Alcohol)
1984	13	0	3	2	1 (Carbon Monoxide)
1985	22	0	1	1	2 (1-Alcohol, 1-Medication)
1986	17	0	2	2	2 (Medication)
1987	12	0	4	1	0
1988	9	1	2	0	0
1989	3	0	1	0	0
1990	3	0	2	0	0
Totals	120	1	18	8	9

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TABLE 9. The Number of Uncontrolled Descents and the Involvement of Spatial Disorientation in Fatal Lost/Disoriented General Aviation Accidents, 1981-90

Year	Fatal Accidents	Descent		Spatial Disorientation		
		Controlled	Uncontrolled	Cause	Factor	?
1981	12	7	5	3	0	0
1982	10	7	3	1	1	0
1983	19	12	7	2	0	3
1984	13	6	7	0	0	2
1985	22	6	16	4	1	4
1986	17	4	13	1	1	2
1987	12	3	9	3	2	2
1988	9	6	3	0	2	0
1989	3	3	0	0	0	0
1990	3	2	1	1	0	0
Totals	120	56	64	15	7	13

small proportions at the lowest (< age 25) and highest (65+) age brackets. Most of the pilots involved in those accidents were between 35-55 years of age with a mean age of 44.7 years; the mean age for all second class and third class airmen during that 10-year period ranged from about 37-39 years (1,2). Moreover, nearly half (45%) of the pilots had 500 or more hours of total logged flying time and an additional 18% had between 200-499 hours of flying experience (Table 6). Data on "hours in type," i.e., in the type of aircraft that was involved in the accident, are less clear due to the fact that those data were not available in 30% of the cases (Table 7). However, of the remaining 84 cases, just over 46% (N=39) of pilots were credited with 100 or more hours in type (Table 7).

Table 8 shows the number of pilots who held other than private certificates at the time of the accidents and the number of pilots who were flying under "altered state" conditions (e.g., alcohol). Only 8 of the pilots were classified as students; their ages ranged from 17-51 years. Only 1 pilot held an air transport rating while 18 others held commercial certificates; all 19 of these pilots were instrument rated. Nine pilots (none of whom were students) were in "altered states" during the accident; toxicological studies indicated that 4 had notable blood alcohol levels (0.038%, 0.054%, 0.124%, and 0.171%), 3 had used medications (Tenormin and Librium; Valium and Darvon; and an unidentified barbiturate), one had used cocaine and "amyl nitrate" (sic; probably amyl *nitrite*), and one suffered from carbon monoxide exposure during flight (the pilot and his 3 passengers had CO levels ranging from 22-44%).

Spatial disorientation (Table 9) was considered to be a cause (N=15) or a factor (N=7) in 22 of the 120 cases. However, there were at least 13 more cases where the described circumstances of the accidents seemed to suggest very strongly that spatial disorientation was involved. Of these 35 total cases only 9 pilots were instrument rated. Moreover, the substantial number of "uncontrolled descents" noted in Table 8 suggest additional possibilities for involvement of spatial disorientation; the available data for many of these accidents are insufficient to draw firmer conclusions.

Discussion

The number of fatal accidents attributed to the pilots' becoming lost/disoriented has declined steadily since 1985. This decline reflects, to some degree, both the steady improvement in general aviation accident statistics (Table 10) and recessionary economic conditions that may have contributed to the reduction in the number of active pilots and the number of hours flown; with respect to the latter, the number declined from 36.8 million hours in 1981 to 30.8 million in

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TABLE 10. The Numbers of Active Airmen, Airmen With Instrument Ratings, Overall Aviation Accidents, and Fatal Accidents, 1981-90

Year	No. Active Airmen	No. Instrument Ratings	No. Accidents	No. Fatal Accidents
1981	764,182	252,535	3,500	654
1982	733,266	256,073	3,233	591
1983	718,004	254,271	3,075	555
1984	722,376	256,584	3,011	543
1985	709,640	258,559	2,737	497
1986	709,118	262,388	2,576	473
1987	699,663	266,122	2,464	431
1988	694,016	273,804	2,369	434
1989	700,010	282,804	2,216	424
1990	702,659	297,073	2,187	435

1990 (5). Another influence for improvement may be the FAA's Accident Prevention Program and the Pilot Proficiency Award Program (Wings) (3) which have recorded increasing participation by pilots in recent years. Of particular relevance are the "Back to Basics" seminars introduced in 1986 as part of the Accident Prevention Program: these seminars specifically address the 12 most prevalent causal factors in aviation accidents.

Table 10 also indicates substantial growth in the number of pilots with instrument ratings, and in their proportion relative to the total number of active pilots (4,5). While that growth is highly desirable, it is also reflective of changes in the airman population. Specifically, while the total number of active airmen has been declining over the past decade, the number of air transport pilots (ATPs) has been increasing. Since all ATPs have instrument ratings, the proportion of private pilots with instrument ratings is not as high as might be inferred from Table 10 data. By correcting for ATPs, the proportions of "other than ATPs" with instrument ratings increased from 27% in 1981 to 32% in 1990. That increase may also represent a contribution to reduced general aviation accidents.

It is clear that there is not a simple, definitive, biodemographic description of pilots who become lost and geographically disoriented as part of a sequence of events that leads to a fatal accident. Over the 10-year period of this study, the average age of pilots who were involved in fatal lost/disoriented accidents was 6-7 years older than the average age of all pilots who did not hold air transport (ATP) ratings. With regard to experience, 46% of the deceased pilots had 500 or more hours of total flying time and only 14% had less than 100 hours. Although there was considerable (30%) missing data for tabulating "hours in type" of the aircraft involved in the accident, the category with the largest representation was that of "100- hours."

However, common to many of the lost/disoriented accidents are concepts associated with planning, judgment, and decision making. Although the cited findings regarding these accidents do not always trace a consistent path, the fact that pilots without instrument ratings make decisions to initiate or continue flight into adverse weather or that instrument-rated pilots disregard weather briefings or advice, or that flights are initiated without weather briefings or flight plans support the need for targeted training such as that in the FAA's "Back to Basics" and "Back to Basics II" programs regarding the importance of flight planning and decision making, and the recognition of individual limitations. Related to this notion of proper preparation is the advisability for general aviation pilots to have a reasonable idea of the terrain along their proposed routes and particularly within some significant radius of the destination airport to reduce the possibility that a "lost" pilot might cruise into elevated terrain while seeking to locate a nearby airport.

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However, the "lost/disoriented" pilot is often faced with the additional problem of spatial disorientation. The 22 cases in which spatial disorientation is attributed as a cause or factor by the NTSB represents 18% of the "lost/disoriented" accidents; if the 13 additional (circumstantial) cases noted by the author are included, the proportion reaches 29%. It is important for general aviation pilots to recognize that becoming lost or geographically disoriented is only part of the problem and that dark nights and unfamiliar routes can hold potent hazards related to spatial disorientation irrespective of clear weather. An indistinguishable horizon, especially on a dark night, effectively constitutes IMC for the pilot even if the weather is VMC .

And finally—and particularly related to spatial disorientation—good instrument skills are essential to many adverse conditions encountered in flight.

Conclusion

Fatal general aviation accidents from 1981-90 that include findings of pilots becoming "lost/disoriented" have declined markedly since peaking in number during 1985. The decline is coincident with the decline in number of all fatal general aviation accidents and may be attributable both to economic conditions affecting the aviation community and to the success of FAA safety programs.

Neither age, general experience, nor student status appears to define characteristics of pilots who become involved in fatal "lost/disoriented" accidents. However, some lack of geographic knowledge of the route and destination airport, limited or no instrument skills, poor or incomplete flight planning, and poor or questionable judgment regarding the advisability of initiating or continuing a flight into adverse conditions seem to characterize many of these accidents. Continued emphasis in safety and training programs regarding proper flight planning and the flight hazards of adverse weather conditions will be needed to maintain or improve these lowered rates of "lost/disoriented" and related spatial disorientation accidents.

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