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U. S. ARMY AEROMEDICAL RESEARCH LABORATORY

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

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SUMMARY PAGE

THE PROBLEM

From the military mission viewpoint, the amount of research effort to be expended on the solution of a given aviation medicine problem must be keyed to its operational cost. In the case of orientation-error accidents involving pilot disorientation and vertigo, little quantified data are available to describe either the incidence or cost of such accidents in aviation. In addition, though such accidents have been long recognized as a major aviation medicine problem, there are few data on hand to describe the direct operational setting for these accidents in terms of the pilot, aircraft, mission, and environmental factors that will be present, singly or in some combination, for each mishap. Until such data are assimilated for a considerable number of orientation-error accidents, optimal method of correction, whether it be, for example, redesign of aircraft, cockpit layout, or instruments, or whether it is a matter of selection, training, and utilization, will not be achieved.

FINDINGS

To initiate the action necessary to establish the magnitude of the orientation-error problem in Army aviation, an interservice research program was organized under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory, the U. S. Army Agency for Aviation Safety, and the Naval Aerospace Medical Research Laboratory. The first step was the construction of an operational definition of an orientation-error accident. The assimilation of data pertaining to the incidence and cause of such accidents and their actual and relative costs in terms of fatalities, injuries, and aircraft damage was then set as the working objective of the program using the master USAAAVS accident files as reference. Accordingly, the decision was made to implement a five-year longitudinal study of all major and minor orientation-error accidents involving Regular Army flight operations beginning with fiscal year 1967. It was decided to summarize the findings on a fiscal-year basis in three separate lines of reports: The first line would be devoted to defining the over-all magnitude of the orientation-error problem in all aircraft types; the second line to the presentation of similar incidence and cost data for accidents involving only the UH-1 aircraft, the predominant rotary wing aircraft in the Army inventory; and the third line to the description of the various pilot/operational factors found to be present in the major orientation-error accidents that occurred in the UH-1 aircraft.

This specific report is the third in the series dealing with the third line, i.e., UH-1 accident factors. A brief case history description is given of each major orientation-error accident that occurred in fiscal year 1969 along with various compilations of related background data including pilot experience, psychological and physiological stress variables, mission pressures, visibility conditions, materiel difficulties, facility limitations, and supervisory factors.

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The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

ACKNOWLEDGMENTS

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INTRODUCTION

To investigate the operational role of pilot disorientation and vertigo in the production of orientation-error type aircraft accidents, the authors have organized an interservice research program under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory (USAARL), the U. S. Army Agency for Aviation Safety (USAAAVS), and the Naval Aerospace Medical Research Laboratory (NAMRL). Since little quantified data were available to describe the actual magnitude of the orientation-error problem in Regular Army flight operations, the decision was made to conduct a five-year longitudinal study, beginning with fiscal year 1967, of all Army aircraft accidents that involved an erroneous judgment of aircraft motion or attitude on the part of the pilot. Two separate, but related, project objectives were set for the longitudinal study. The first was to extract and assimilate the data from the USAAAVS master aircraft-accident files which would define the actual and relative cost of orientation-error accidents to Regular Army flight operations. These data, by defining the operational magnitude of the problem, would then serve to define the extent of the research support that should be devoted to its solution. The second working objective was to extract data on a case-history basis which would describe the various pilot/aircraft/mission/environmental factors found to be present in each of the orientation-error accidents. Assimilation and analysis of these data over the study period would result in better knowledge of the most common operational causes of orientation-error accidents and thus point out those research directions which offer the greatest potential toward the reduction of accident incidence.

The results of the longitudinal study are being summarized in three separate lines of reports, with one report in each line prepared for each fiscal year of the five-year study. The first line of reports for example, refs. 1,4,and 7) is devoted to defining the incidence and cost of all major and minor orientation-error accidents involving all aircraft types, fixed wing as well as rotary wing, that occurred in Regular Army flight operations for each fiscal year. Since the UH-1 "Huey" helicopter has been, and is, the predominant aircraft in the Army rotary-wing inventory, the second line of reports (for example, refs. 2,5, and 8) is devoted to defining the magnitude of the orientation-error accident problem in only this aircraft. The layout and format of this line of reports are almost identical to those of the first line. The third line of reports (for example, refs. 3 and 6) deals exclusively with the various causal factors found to be present in all of the UH-1 major orientation-error accidents. Typical data to be presented include phase of flight, time of day, type of mission, pilot experience, physiological factors, psychological factors, facility factors, environmental factors, and the like.

This specific report is the second in the series dealing with accident factors and concerns only those major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1969. To facilitate the comparison of these factor data with similar data derived for other fiscal years of the longitudinal study, the layout and numbering of the figures presented in this report are identical to those presented previously (refs. 3 and 6). The various rationales involved in both the definition of the orientation-error class of accidents and the analysis of the related accident factors are discussed in detail in the first report of the series (ref. 3). It is of particular importance that the reader recognize

that the accident details contained in this report derive solely from the written records contained in the master file associated with each accident. Accordingly, the extent of the factors that can be listed for a given accident is dependent entirely on the extent of the documentation entered into the record by the field investigation team and its reviewing authorities. The authors wish also to caution against any interpretation of the report data for a given fiscal year that assigns one single factor as the sole causal agent for either a given accident or the entire class of accidents. Though degraded visibility is probably the single most predominant factor in orientation-error accidents, there are usually present additional factors or events, any of which, if eliminated singly, might possibly have prevented the accident. In this context, the listing of a given factor in this report implies only that it was present -- it may or may not have played a causal role. The weight of a given factor as a contributing element will be best judged upon completion of the five-year data assimilation period.

PROCEDURE

A basic requirement for the commencement of this study was a workable definition of the class of accidents to be defined as involving orientation error. The reader is referred to previous reports (refs. 1,2, and 3) for a comprehensive definition and discussion of its rationale. Briefly, orientation is considered to involve the correct determination of the dynamic position and attitude of an aircraft in three-dimensional space. The key word here is dynamic, which implies that full knowledge of the motion as well as static attitude and position is required to define its instantaneous spatial orientation. Accordingly, a pilot is considered to have made an orientation error whenever his perception of the motion and attitude of his aircraft differs from the true motion or attitude, i.e., the true orientation of the aircraft. An orientation-error accident is then defined as one that occurs as a result of an incorrect control or power action taken by a pilot (or a correct action not taken) due to his incorrect perception (or lack of perception) of the true orientation of his aircraft.

With this definition of orientation-error accidents serving as a classification reference, an experienced classifier read all briefs in the USAAAVS master accident files and selected all major and minor accidents of this type occurring during fiscal year 1969. For redundancy, the entire accident files were also searched by sifting the coded summaries that USAAAVS prepares for each accident for a wide range of indicator terms.

The authors then reviewed the accident briefs independently for the purpose of establishing whether or not an orientation-error accident classification would result. In addition, the comprehensive master file on each suspect accident was obtained and reviewed. Whenever there was serious question as to the contribution of orientation error to the accident, or where equally weighted alternative causal factors were present, then the accident was not included in the classification. The net effect of this policy is to give a conservative estimate of the magnitude of the orientation-error accident problem.

From the resulting listing of all major and minor orientation-error accidents that occurred in both fixed wing and rotary wing aircraft, separate identification was made of

only those major accidents that occurred in UH-1 aircraft. The master file on each of these UH-1 accidents was then obtained from USAAAVS for review as described previously (ref. 3). In brief, the basic factor data were extracted from the files by the classifier using a combination check-list/narrative type questionnaire developed by the authors of this report. In addition, the classifier and the authors prepared independent check-list summaries of selected accident details represented by the factors data compiled in figures shown later in this report.

RESULTS AND DISCUSSION

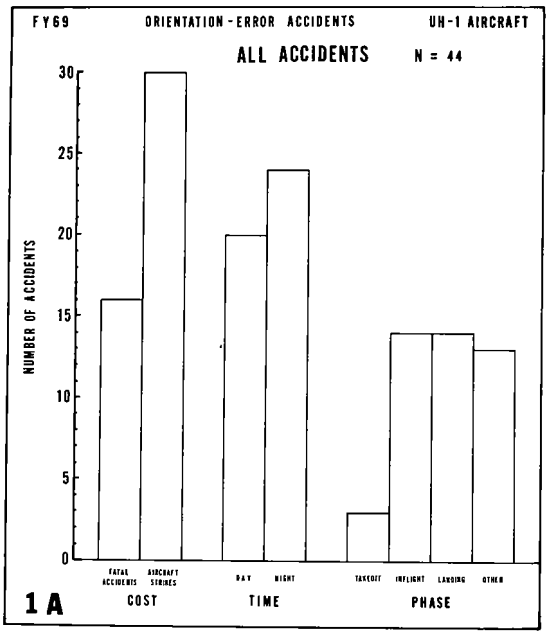
The search of the fiscal year 1969 accident files resulted in an orientation-error classification for 44 UH-1 Regular Army major aircraft accidents. Of this total, 16 accidents resulted in one or more fatalities and 30 accidents resulted in total strike damage to the aircraft. In terms of personnel, these 44 accidents accounted for 39 fatalities and 67 nonfatal injuries.

As indicated by the cost data presented in Figure 1A, the hazard of the orientation-error class of accidents was considerable for that fiscal year. Some 36.4 percent of the accidents were fatal, while 68.2 percent resulted in a total loss of the aircraft. The time-of-day data indicate that the incidence of accidents at night was slightly greater than the incidence during daylight. In terms of the phase of flight in which the accident occurred, 31.8 percent of the accidents occurred during the inflight phase, 31.8 percent during the landing phase, 29.5 percent during the "other" phase, and 6.8 percent during the takeoff phase. It should be noted that the "other" phase classification used in this report denotes localized operations, such as reparking an aircraft, lifting a sling load, or moving an aircraft to a nearby refueling site.

The mission data shown in Figure 1B indicate that the majority (63.6 percent) of the accidents occurred on flights that had some form of combat-related mission assignment. This would be expected since 37 (84.1 percent) of the accidents occurred in Vietnam. The reader is reminded that, although a combat mission may have been assigned to the crew, the resulting mishap was an accident and not a loss attributable to direct enemy action.

In Figure 2A a distribution is given of the number of accidents during each month of the fiscal year. Since the majority of the accidents occurred in Vietnam, the time-of-year incidence of accidents due to weather and dust peaked in that country's monsoon and dust seasons, respectively. Interpretation of these data beyond this point is restricted by the month-to-month variations in the level of combat operations being conducted at a given time. Similarly, the daily variation in frequency of operations would affect interpretation of the hourly distribution data plotted in Figure 2B, which shows accident incidence in 2-hour increments over a 24-hour period.

Additional data related to the time-of-day incidence of the orientation-error accidents are presented in Figure 3. Statistics pertaining to the 20 accidents that occurred under daylight visibility conditions are plotted in Figure 3A. Similar data for the 24



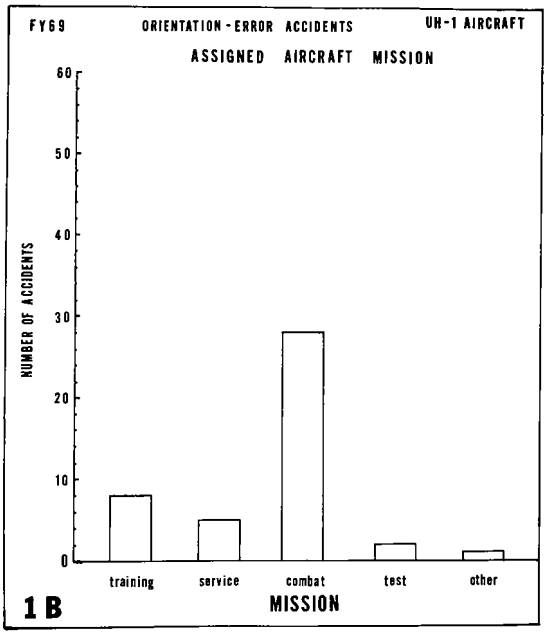
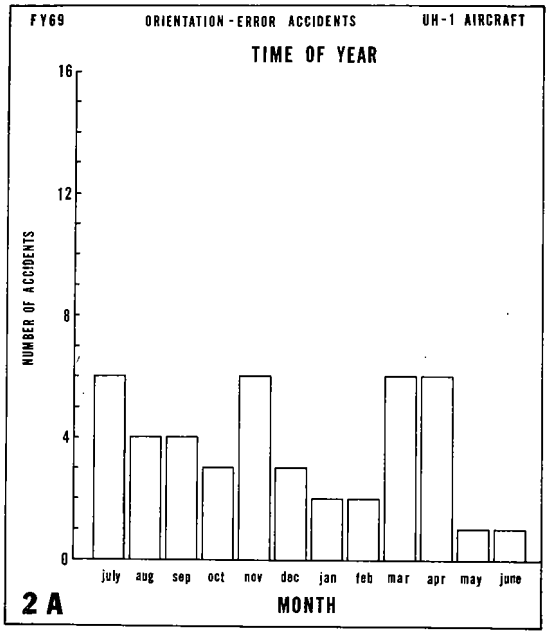


Figure 1

Major orientation-error accidents occurring in Regular Army UH-1 aircraft during fiscal year 1969. Number of fatal accidents, number of aircraft strikes, time of day of the accidents, and the flight phase in which the accident occurred (A); and types of missions assigned to the accident aircraft (B).



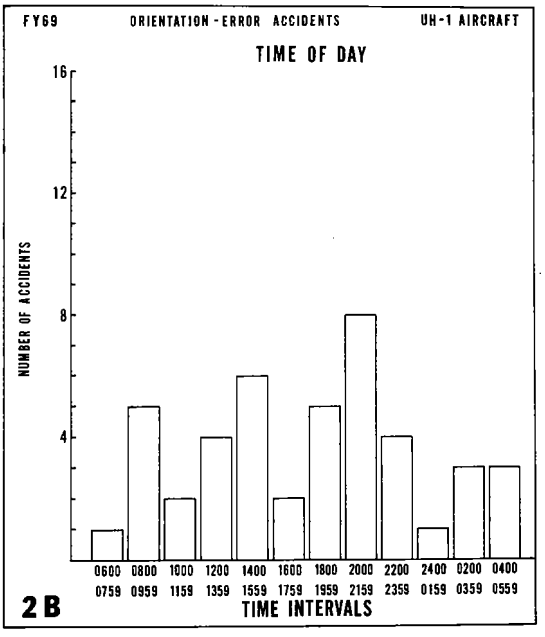
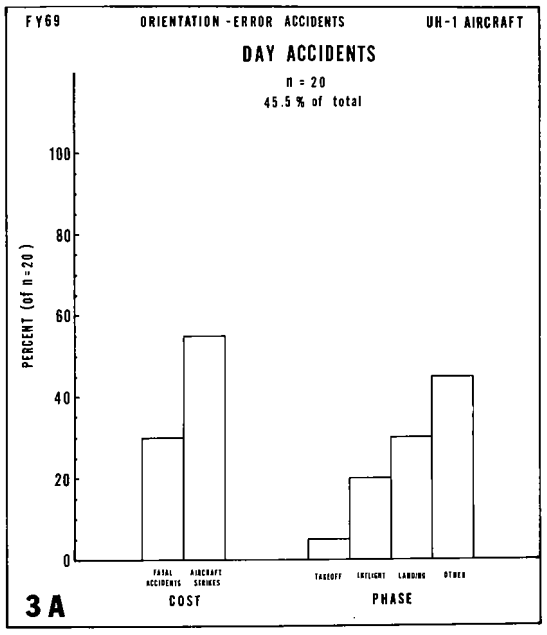


Figure 2

Number of orientation-error accidents as a function of the time of year (A) and the local time of day (B).



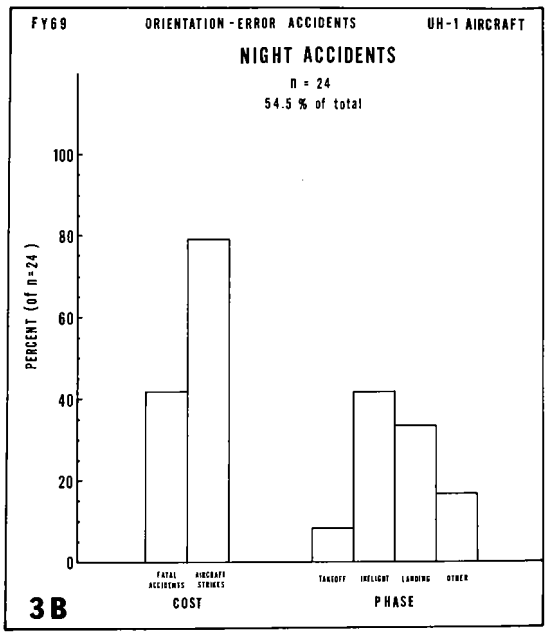
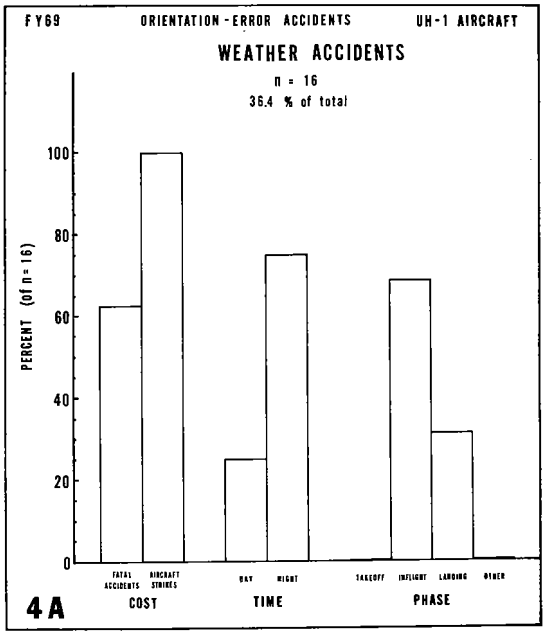


Figure 3

Comparison of percent incidence of fatal accidents, aircraft strikes, and flight phase for the 20 orientation-error accidents that occurred under daylight visibility conditions (A) and the 24 accidents that occurred under night visibility conditions (B). Note the considerably greater hazard of the night flights.



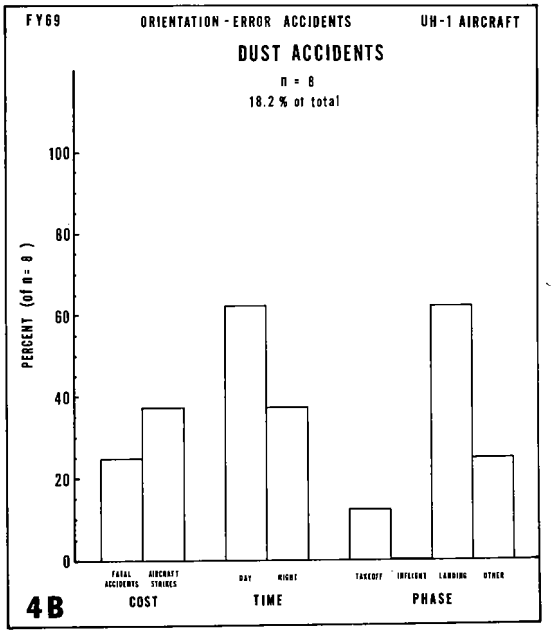


Figure 4

Comparison of percent incidence of fatal accidents, aircraft strikes, day/night accidents, and phases of flight for the 16 orientation-error accidents that involved poor weather (A), and the 8 accidents that involved rotor-raised ground dust or ashes (B). Note the high incidence of fatal accidents and aircraft strikes involved in the weather accidents.

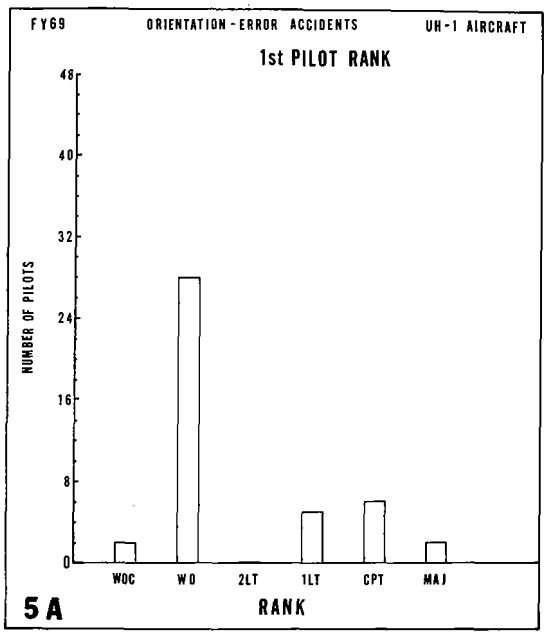
night accidents are shown in Figure 3B. It is obvious that the cost of night accidents in terms of fatal accidents and aircraft strikes was considerably greater than the corresponding costs for daylight accidents. That is, 41.7 percent of the night accidents were fatal as compared to only 30.0 percent of the daylight accidents; 79.2 percent of the night accidents resulted in aircraft strikes as compared to only 55.0 percent of the daylight accidents. In terms of the phase of flight for the night accidents, the greatest incidence occurred during the inflight phase (41.7 percent) followed by the landing, "other" and takeoff phases. For daylight accidents, incidence was greatest during the "other" phase (45.0 percent) followed by the landing, inflight, and takeoff phases.

Data pertaining to accidents involving degraded visibility due to weather and rotor-raised ground dust are presented in Figure 4. As denoted in Figure 4A, poor weather of one form or another was present in 16 (36.4 percent) of the 44 orientation-error accidents. The hazard of these weather accidents was most significant since 62.5 percent of the accidents were fatal and all resulted in aircraft strikes. A further significant feature was that the majority (75.0 percent) of the accidents occurred at night. Of the 12 accidents that occurred under these special conditions, i.e., visibility degraded both by weather and by darkness, 7 (58.3 percent) were fatal. Of the four weather accidents that occurred during daylight, three were fatal. With respect to the total of 10 fatal weather accidents, 7 (70.0 percent) of these occurred at night. In terms of the phase of flight when the accident occurred, the inflight phase had the greatest incidence (68.7 percent).

As indicated in Figure 4B, an additional 8 (18.2 percent) of the 44 orientation-error accidents involved degraded visibility due to rotor-raised ground dust. There were only 2 fatal accidents and 3 aircraft strikes in this classification. In contradistinction to the weather accident data, the majority (62.5 percent) of the dust accidents occurred under daylight visibility conditions. Relative to the phase of flight, landing accidents had the greatest incidence (62.5 percent) followed by the "other" and takeoff phases.

In Figures 5 through 9, summary listings are made of various aviator-related background information. For each figure, a separate compilation is made for each of the two Army pilots normally aboard the UH-1 aircraft. The terms "first pilot" and "second pilot" have been arbitrarily selected to identify the commanding aviator (not necessarily the senior-ranked aviator) and his copilot, respectively. Outside of Vietnam, the first and second pilot notation corresponds to the conventional pilot (P) and copilot (CP) identification. In Vietnam, however, the two aviators are usually identified as the air commander (AC) and pilot (P); the air commander rating applies only after an aviator gains a certain minimum of in-country experience within the air unit to which he is assigned. An air commander is thus identified as the first pilot and the pilot as the second pilot in this report. In the case of student aviators, the individual assigned to fly the aircraft at the time of the accident is identified as the first pilot. Because of incomplete field reports, the total number of pilots will usually vary from figure to figure.

Data pertaining to the military rank of the first and second pilots are shown in Figures 5A and 5B, respectively. Of the 43 first pilots for whom rank data were available, 13 (30.2 percent) individuals had a rank of second lieutenant or above. Similarly,



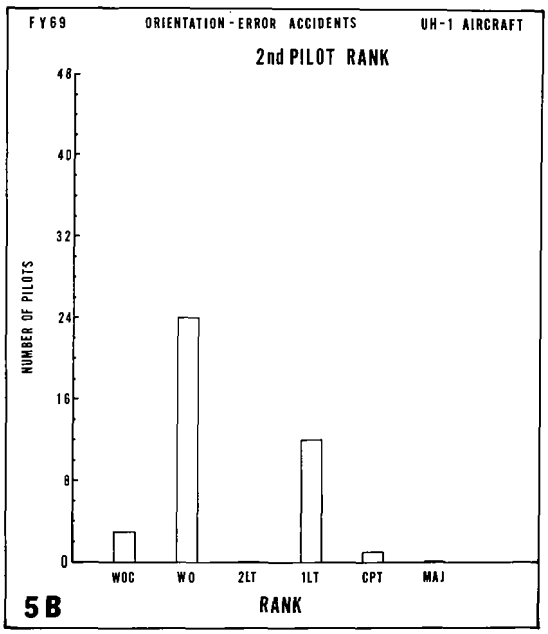
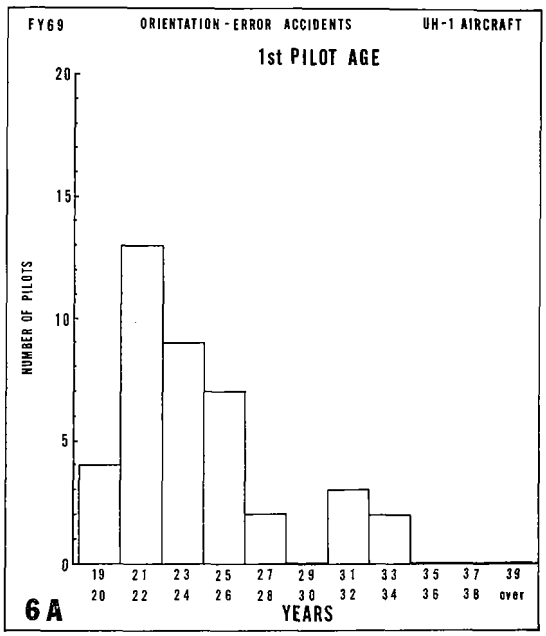


Figure 5

Distribution by rank of 43 first pilots (A) and 40 second pilots (B) involved in the orientation-error accidents. As explained in the text, the first pilot notation is used to describe the commanding aviator aboard the aircraft. In general, for Vietnam accidents, the first pilot is the "air commander" and the second pilot is the "pilot." For accidents occurring elsewhere, the first and second pilot notation usually corresponds to the conventional "pilot" and "copilot" designations, respectively.



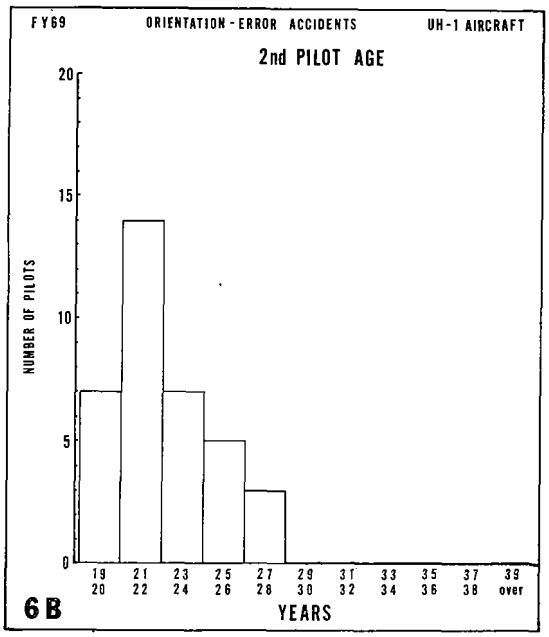
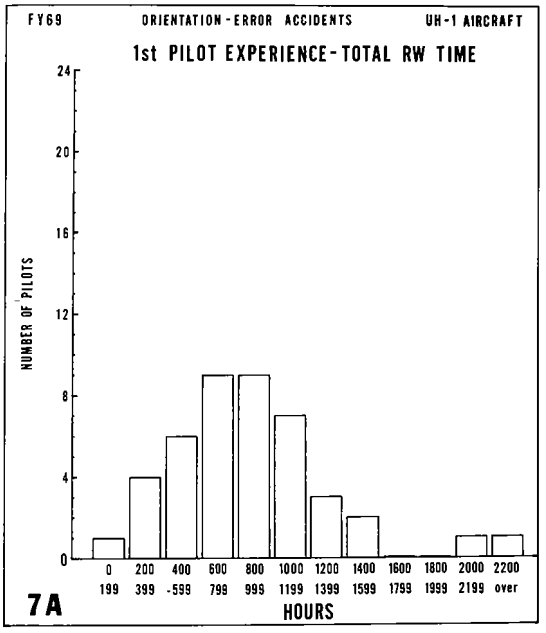


Figure 6

Age distribution of the first pilots (A) and second pilots (B). The median ages were approximately 23.7 years and 22.6 years, respectively.



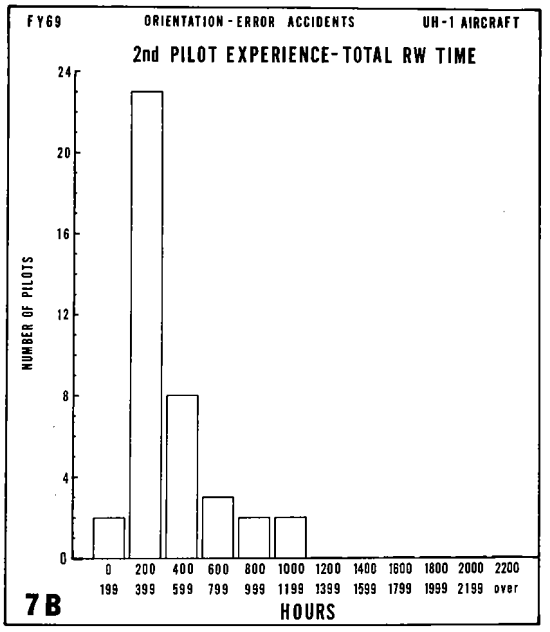
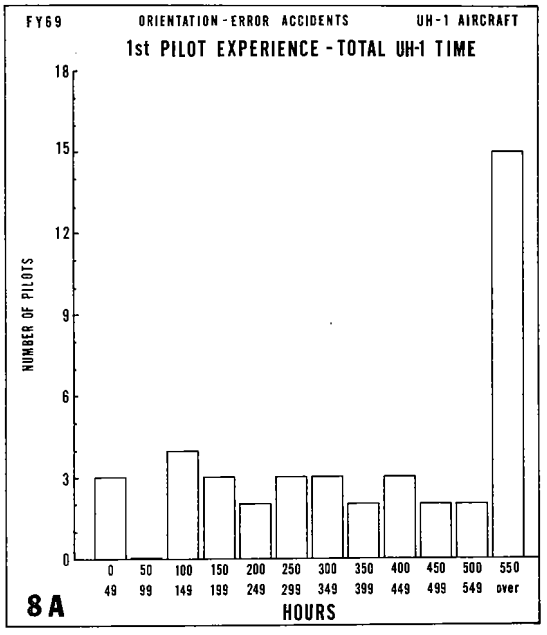


Figure 7

Distribution of total flight hours experience in military rotary-wing aircraft of the first pilots (A) and second pilots (B). The medians were approximately 833 hours and 356 hours, respectively. These data do not include any additional fixed-wing experience. (See Figure 10 for related FW and RW experience data.)



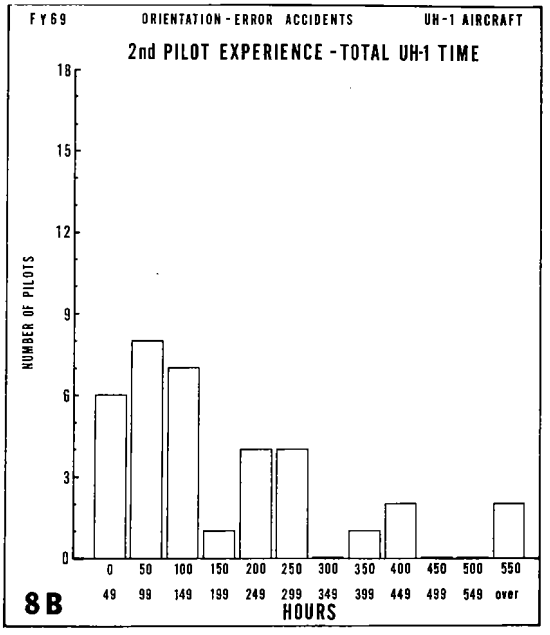


Figure 8

Distribution of total flight hours in the UH-1 aircraft of the first pilots (A) and second pilots (B). The median times were approximately 417 hours and 125 hours, respectively. (See Figure 10 for related UH-1 experience data.)

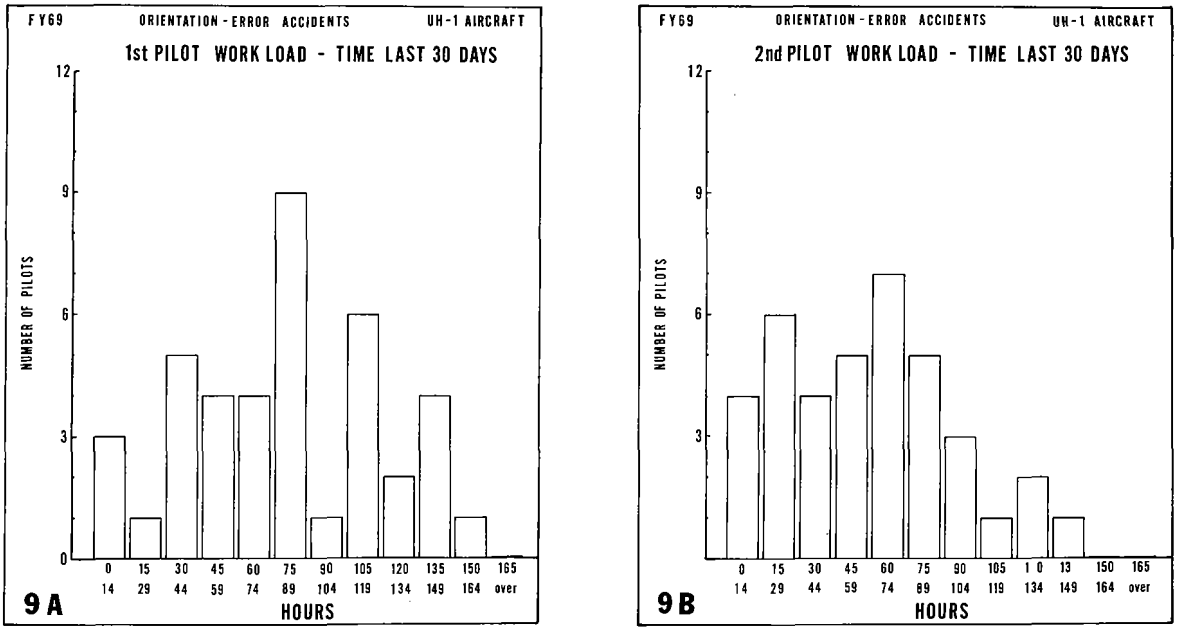


Figure 9

Distribution of pilot workload in terms of the total number of hours flown the 30 days preceding the accident by the first pilot (A) and the second pilot (B). The median workloads were 80 hours and 60 hours, respectively. (See Figure 10 for related fatigue listings.)

for 40 second pilots, 13 (32.5 percent) individuals had a rank of second lieutenant or above. The age distribution data presented in Figure 6A for 40 first pilots indicates a median of 23.7 years; the Figure 6B data indicate a median of 22.6 years for 36 second pilots.

Aviator experience in terms of total flight hours both in all types of military rotary-wing (RW) aircraft and in the UH-1 aircraft is described by Figures 7 and 8, respectively. The median for the total recorded RW experience data presented in Figure 7 was 833 hours for 43 first pilots and approximately 356 hours for 40 second pilots. The median times for total UH-1 experience were approximately 417 hours and 125 hours for 42 first and 35 second pilots, respectively.

Work-load data concerned with the total number of hours flown by the aviators during the 30 days preceding the accident are shown in Figure 9; specific hours data were available for 40 first pilots and 38 second pilots. The median times were approximately 80 hours for the first pilots and 60 hours for the second pilots. Army regulations place 140 hours per 30-day interval as the official upper limit relative to pilot fatigue. After 90 hours, however, observation of the pilot by the air unit commander and flight surgeon is required.

Before listing the various factors found in an individual accident, a case history of each accident is presented, with the objective of acquainting the reader with the general nature of the orientation-error problem in actual flight operations. The first

paragraph of each account lists in the designated order: accident location; the type mission assigned to the crew; the phase of flight in which the accident occurred; the time of day of the accident in terms of either night or daylight visibility conditions; the number of persons aboard the aircraft; the number of fatalities, major injuries, and minor injuries; and the presence of aircraft strike damage. The second paragraph presents a brief narrative of the accident proper.

CASE BRIEF 69-1

Vietnam: training mission; flight phase--inflight; day flight; two persons aboard--one fatality and one major injury; aircraft strike damage.

P on first in-country flight practicing low-level forced landings under supervision of IP. Different maneuvers demonstrated by IP, followed by P practicing same. Upon completion of training, IP relieved P at controls and began a climbing left turn from an altitude of approximately 50 feet. Aircraft descended into ground during turn, impacting with left skid low. Surviving IP stated, "One minute I was in the air and the next second I hit the ground with no warning and for no apparent reason--it all happened so fast."

CASE BRIEF 69-2

Vietnam: combat mission--reconnaissance; flight phase--other; day flight; four persons aboard--no injuries.

Crew returned to base camp to rearm and refuel prior to going back on station. After rearming near revetments, AC lifted aircraft to hover, with the objective of moving aircraft to refueling site. At low hover, AC started turn to right. Aircraft drifted right and to the rear, resulting in tail rotor striking main rotor of nearby aircraft. Crew member on right side still putting on flight helmet when aircraft lifted to hover and therefore not in a position to advise pilot of drift.

CASE BRIEF 69-3

Vietnam: service mission; flight phase--landing; night flight; four persons aboard--one fatality and two minor injuries; aircraft strike damage.

Crew assigned night mission to pick up passengers on nearby ship after flying 10 hours during an 18-hour work day. Crew had missed breakfast and eaten only one C-ration during day. After establishing visual contact with ship on a dark moonless night, with heavy cloud overcast, AC began gradual descent. Passed through several layers of "flare smoke and/or clouds" which slightly obscured view of landing deck. AC stated, "The deck became dim and fuzzy." Soon thereafter, aircraft impacted water short of ship at an airspeed of 35 knots.

CASE BRIEF 69-4

Vietnam: combat mission--reconnaissance; flight phase--inflight; night flight; four persons aboard--one fatality, two major injuries, and one minor injury; aircraft strike damage.

Two aircraft returning to base under VFR conditions when ground fog, clouds, and rain showers encountered. Lead aircraft went IFR for about 30 seconds and made a 180-degree turn to get out of weather. When again VFR, lead aircraft changed course and headed for home base. Following aircraft, still IFR, did not perform a 180-degree turn but instead vectored toward the lead aircraft which was known to be VFR at 1200 feet. Since the second aircraft was at 1500 feet, AC began a gradual descent to 1200 feet. Soon thereafter, aircraft impacted ground at an estimated 25-degree angle while still IFR.

CASE BRIEF 69-5

United States: training mission; flight phase--other; night flight; two persons aboard--no injuries; aircraft strike damage.

SP hovered aircraft from parking area on a dark night, with field dimly illuminated to simulate a typical tactical environment. Navigation lights went out as aircraft entered hover condition. SP had begun a turn to the left when he lost sight of the ground and couldn't locate ground guide. Aircraft began an undetected drift to the right toward a nearby aircraft. When SCP saw aircraft, he shouted warning to SP who then applied hard-left cyclic. Rotor blades struck ground, and aircraft rolled over on its side. Both pilots thought they were at a stationary hover.

CASE BRIEF 69-6

Vietnam: combat mission--resupply; flight phase--takeoff; night (dusk) flight; six persons aboard--four minor injuries; aircraft strike damage.

P missed the first approach to a confined area landing zone and was relieved at controls by AC who completed second approach. Though there was still some daylight left, the landing zone was in the deep shadow of a mountain. After offloading supplies, two passengers came aboard, with crew not notifying pilots of their presence. AC lifted aircraft to a hover and attempted to back out of area. Aircraft drifted right and tail rotor struck a tree.

CASE BRIEF 69-7

Vietnam: combat mission--assault; flight phase--inflight; night flight; four persons aboard--one major injury and one minor injury; aircraft strike damage.

Two aircraft assigned to evacuate a night reconnaissance patrol undergoing attack. While enroute, weather deteriorated, forcing flight to return toward home base. Accident aircraft became separated from wingman when flight conditions went IFR. Requested GCA assistance, but identification could not be made because of distance and thunderstorm activity. Encountered severe turbulence and notified control they were going to make a 180-degree turn. Although bothered by vertigo, both pilots were able to control the aircraft in turbulence. AC decided to set down through clouds and stated, "At that time I thought I was going into vertigo. I checked instruments and we were losing altitude, so I pulled pitch and applied aft cyclic. We came out of the clouds but we couldn't see a thing, then the C.E. said we had trees close by and about then we started churning into the jungle." At the time of the crash both pilots were on the controls. P had flown over 100 hours during the past 30 days.

CASE BRIEF 69-8

Vietnam: combat mission--med-evac; flight phase--inflight; night flight; five persons aboard--two minor injuries; aircraft strike damage.

Enroute to pickup site, crew observed lightning and heavy rain to one side of their route. Landed, picked up patient, and departed following lightning-illuminated highway toward home base. While at 2000 feet, AC forced to descend in attempt to get under weather. Though it was raining hard, AC stated he could see ground and was VFR. As weather closed in, visibility went IFR. It was later determined that AC and P disagreed on actual altitude of aircraft at time visibility went IFR. AC said he never went below 1500 feet while the P estimated his actual altitude at 300 to 500 feet. However, P expressed no concern to AC. At about this time, P discovered that his intercom switch was off. He then turned it on in time to hear AC request that position lights be turned off and that searchlight be turned on. AC then began what he thought was a climbing turn (AC and P later disagreed on the direction of the turn). Soon thereafter, aircraft impacted the ground. Board stated that neither pilot had set his altimeter before the flight.

CASE BRIEF 69-9

Vietnam: combat mission--support; flight phase--landing; day flight; four persons aboard--no injuries; aircraft strike damage.

Aircraft made low reconnaissance of field landing site and started approach, with wind at 10 knots gusting to 25 knots. During the approach AC warned P about the nearness of a building to the right. P made a correction to the left and flared aircraft near river bank adjacent to touchdown point. Flare altitude was too low, resulting in the tail skid hitting bank and tail rotor becoming enmeshed in concertina wire. P stated, "The AC called my attention to the building just to the right of the pad saying not to get close. I turned my attention to the building momentarily whereupon the tail rotor contacted some concertina wire." AC and P had flown 151 and 139 hours, respectively, during the preceding 30 days. AC had flown 14 sorties during the preceding 24 hours.

CASE BRIEF 69-10

Vietnam: combat mission--med-evac; flight phase--other; night flight; four persons aboard--no injuries.

Aircraft returning from completed mission terminated descent above runway and started to hover toward confined revetment area. As aircraft passed operations office, P stated, "A floodlight blinded me for an instant." He requested operations to turn off light, and continued on toward parking area. Made a left-pedal turn, and aircraft drifted to one side, with tail rotor striking main rotor of parked aircraft.

CASE BRIEF 69-11

Vietnam: service mission; flight phase--landing; night flight; two persons aboard--two minor injuries; aircraft strike damage.

Takeoff made with the objective of repositioning aircraft behind a counter-mortar revetment. Weather was marginal, with unit alerted to expect rain and high winds from typhoon expected to move toward base. During the landing approach, while flying at about 100 feet, the visibility went IFR due to heavy rain. When visual contact with ground lost, AC went on instruments and requested P to turn on windshield wipers. AC determined aircraft was in a 30-degree nose-high attitude and a 20- to 25-degree right bank. AC leveled the aircraft laterally and began descent, thinking he was maintaining his previous airspeed of 60 knots. P noticed airspeed and altitude indicator read zero, looked outside, and from area illuminated by searchlight determined that they were moving backward about 30 to 40 feet above the ground. Aircraft hit ground in a slight nose-low, left-bank attitude.

CASE BRIEF 69-12

Vietnam: training mission--proficiency; flight phase--other; day flight; two persons aboard--no injuries.

IP giving an in-country orientation and standardization checkout to P. Accident occurred on third autorotation maneuver. IP demonstrated first autorotation, allowed P to make second with help provided only during the touchdown, and gave complete control to P on third. During touchdown aircraft went into an "extreme nose-high attitude," with tail stinger impacting ground. IP stated, "--at no time did I feel the need to assist as everything seemed normal until after initial touchdown when I noticed the tail rotor blade fly past the right side of the aircraft." P had similar lack of perception of an unusual attitude stating, "Entry into autorotation was normal and it seemed that the deceleration and initial pickup was normal. It was after initial pullup that I felt a thud in the aircraft. I was not aware of any abnormality in the attitude of the aircraft when it struck the ground."

CASE BRIEF 69-13

Vietnam: combat mission--Firefly; flight phase--inflight; night flight; six persons aboard--two fatalities, three major injuries, and one minor injury; aircraft strike damage.

AC, who had flown 14 hours that day, was flying the low-gunship position in the Firefly team. After completing mission, team was returning at 1500 feet to base when AC initiated a descent to 700 feet. At this point, AC stated he saw a helicopter ahead of him and started a descent. The P later stated he never did see a helicopter in their path. Aircraft impacted ground at 80 knots in a slightly nose-low attitude. AC stated,"As soon as I hit the ground the lights came on. We had the landing light and searchlight extracted. As soon as we hit the ground the lights came on and that's the first I knew I was on the ground. I realized right then that I just flew into the ground." Board mention of fact that during a portion of the descent, AC was busy at overhead panel attempting to turn on rotating beacon.

CASE BRIEF 69-14

Vietnam: combat mission--reconnaissance; flight phase--inflight; night flight; three persons aboard--two fatalities and one major injury; aircraft strike damage.

Crew departed on mission, climbing out to 500 feet where visibility went IFR in clouds and rain. Unverified report received that the crew radioed for GCA assistance. Soon thereafter AC lost control of aircraft, resulting in a steep dive. AC was able to make a "high-G force" recovery from the dive, but during the levelout aircraft impacted a steep hillside deep in a river canyon. Surviving crew member reported, "We went into a steep dive attitude. I put my hands up against the roof. The P, he was sitting in the pilot's seat, was the first to recognize we were in a dive. The AC tried to pull out but we were already into it and the blades started to stall. Then we hit the hill and crashed."

CASE BRIEF 69-15

Vietnam: combat mission--med-evac; flight phase--landing; night flight; six persons aboard--one major injury and four minor injuries; aircraft strike damage.

Crew assigned night med-evac mission under marginal weather conditions. Upon arriving over the pickup site contact with the ground unit via an onboard interpreter was attempted, but language difficulties prevented full communication. AC elected to make pickup even though ground illumination came from only four small fires. With P at controls, a steeper than normal descent was started into the tree-lined area. Rate of descent was excessive, and as crew chief warned of upcoming trees, AC came on controls to build up pitch but not in time to prevent a tail rotor strike.

CASE BRIEF 69-16

United States; training mission; flight phase--landing; night flight; five persons aboard--no injuries.

Major in need of flight time to meet night minimums assigned as P of number-three ship in a four-ship formation practicing night landings under tactical illumination conditions. Before flight, operations officer told CP to "leave the landing lights off because it was too dangerous in the extremely dusty conditions." The night was dark, with no clear horizon but with clear skies. On first approach with P at controls, ground vehicle moved into landing area and flight made a go-around. During second approach, visibility went IFR, and aircraft impacted ground 750 feet short and to the left of the intended landing area. CP stated, "The lead aircraft put on his landing light causing us to be unable to see the ground. There was a refueling truck on the ground with lights pointing toward us. With the landing lights, the truck lights, and all the dust kicked up by the lead aircraft, we were unable to see the ground clearly." Though P relatively experienced, he had little recent flight time and had not participated in a night formation flight during the preceding 2 years. In addition, he had logged only 18 hours in the UH-1 aircraft.

CASE BRIEF 69-17

Vietnam: combat mission--med-evac; flight phase--inflight; day flight; four persons aboard--four fatalities; aircraft strike damage.

Crew assigned a med-evac mission under marginal weather conditions. Aircraft descended through hole in overcast, and AC reported that the pickup field was in sight. Another aircraft approximately one mile ahead radioed to the med-evac ship that the weather was rapidly deteriorating and advised aborting the mission. Med-evac ship radioed a roger but continued toward site. Soon thereafter, aircraft impacted ground. Weather at crash site was overcast at 20 feet, with visibility less than 1/16 mile. AC and P had flown 142 and 134 hours, respectively, during the preceding 30 days. Friends of the crew reported, "Both aviators were irritable and seemed fatigued during the 48-hour period preceding the crash."

CASE BRIEF 69-18

Vietnam: test mission--maintenance; flight phase--other; night flight; two persons aboard--no injuries.

P assigned a night checkout of aircraft that had recently undergone maintenance. Made takeoff without a CP aboard and ran through a series of tests. At an approximate altitude of 300 feet, the engine failed, and P placed aircraft into an autorotation descent. Since the moon was bright, he elected not to use the landing or searchlights. P stated, "The moon was bright enough to show reflections on the rice paddies and I picked one I had seen earlier to land in." The decision was also made to land with zero airspeed because of the rice-paddy water. Though a near-zero airspeed was achieved, aircraft attitude was not level at touchdown. Aircraft impacted water nose low, with right skid sliding forward about 3 feet, and aircraft finally rolling over on right side.

CASE BRIEF 69-19

Vietnam: combat mission--support; flight phase--landing; day flight; four persons aboard--no injuries; aircraft strike damage.

Involved aircraft part of a formation flight making a landing approach to a rice-paddy pickup zone. Flight leader advised flight that he would be making a steep approach to the landing zone. As accident aircraft started descent, AC stated he lost visual contact with the smoke flare identifying the touchdown point. Ground commander advised AC to land even though he could not see the smoke. AC misjudged rate of descent and altitude such that when the aircraft was flared, a tail rotor strike resulted. AC had flown 133 hours during the preceding 30 days, and 13.8 hours during the preceding 24 hours.

CASE BRIEF 69-20

Vietnam: combat mission--med-evac; flight phase--landing; night flight; five persons aboard--five minor injuries.

Aircraft arrived over pickup site on a dark night with no visible horizon. AC instructed by pathfinder to make a blackout approach even though there was no tactical demand for a lights-out landing. On short final, P lost sight of pathfinder, and AC took over controls, with visibility being further degraded by rotor-raised dust. Aircraft began to drift, and pathfinder radioed AC that he was dangerously close to the concertina wire on his left. Since this command was shouted, the pilots did not understand what he said. Second pathfinder with hand beacons heard radio command to pull up and began running away from landing site. AC saw second pathfinder's lights begin to move to his left so he logically turned aircraft in that direction. When AC recognized the emergency, he made a right pedal turn and climbed to approximately 100 feet. In an attempt to gain rpm, AC lowered pitch, with P staying on instruments and attempting to limit the amount of collective applied by AC. With no outside ground references due to darkness, dust, and the nonuse of landing lights, right skid hit windsock pipe, causing aircraft to roll to such an extent that the main rotor struck the ground. P stated that during descent, "I grabbed the controls and just leveled it with the instruments. That's all I could see to do. I couldn't see out of the aircraft or anything else. I got it level and we hit."

CASE BRIEF 69-21

Vietnam: combat mission--assault; flight phase--other; day flight; four persons aboard--no injuries.

Two aircraft had terminated landing at a hover over an abandoned road running through water-covered rice-paddy area. AC of accident aircraft asked crew if area beneath was clear to setdown. Because of an unusual amount of radio traffic, crew did not hear request. AC then took hand off collective and moved the communication panel switches to the "intercom" position. Aircraft drifted forward, with main rotor striking tail rotor blades of aircraft to his front. Neither AC not P sensed the drift.

CASE BRIEF 69-22

Vietnam: test mission--maintenance; flight phase--takeoff; night flight; two persons aboard--two fatalities; aircraft strike damage.

P who had been on duty 16 hours assigned night test flight of aircraft in which he had not received a proficiency check. Made takeoff on a dark moonless night without a CP aboard. Aircraft placed in a straight climb to an altitude of 150 feet. When approximately 1500 feet from end of runway, a right turn over water was initiated. Aircraft observed to gradually descend and finally impact water in a near-level attitude. Landing lights not used at any time. This was the third flight of the evening for the P. Crew chief who had flown with P on the two earlier flights observed that after the second flight, P had stated he was tired and would wait until morning to complete the tests.

CASE BRIEF 69-23

Korea: service mission; flight phase--inflight; day flight; five persons aboard--five fatalities; aircraft strike damage.

Crew had made previous stop to offload passengers and were enroute to destination of remaining passenger when low ceiling encountered. AC, who Board reported had had no previous experience flying in bad weather, climbed above clouds. Weather had been forecast to be at freezing level at 5000 feet. AC then called destination, asking GCA assistance and mentioning that he had not brought navigation maps on flight. Field informed him that though GCA was not available, they would provide radar vector service. AC then followed vector instructions which placed him initially over water approximately 10 miles from field. With rain and heavy turbulence present at field site, AC radioed that he was descending into clouds at 8500 feet. Approximately 12 seconds later, aircraft disappeared from radar. Board mentioned that pitot heating probably not used in icing conditions, with possibility that accurate airspeed, vertical velocity, and altimeter data would not have been available to the crew when flight went IFR.

CASE BRIEF 69-24

Vietnam: service mission; flight phase--landing; day flight; eleven persons aboard--one minor injury; aircraft strike damage.

Aircraft arrived over landing site and decided to orbit field, waiting for ground fog to burn off. Shortly thereafter, AC found an opening in the fog and decided to attempt a landing. As he descended, visibility deteriorated, finally going IFR. During attempt to decrease airspeed, aircraft nose went high, resulting in a tail rotor strike. AC had been in a previous orientation-error accident.

CASE BRIEF 69-25

Vietnam: combat mission--med-evac; flight phase--inflight; night flight; four persons aboard--two fatalities, one major injury, and one minor injury; aircraft strike damage.

AC decided to attempt a night med-evac mission, even though weather conditions marginal, since mission was classified as urgent. AC made takeoff and initiated a climb toward 5000 feet. At approximately 3000 feet, AC turned controls over to P, with visibility IFR due to clouds and rain. At this time all instruments seemed to function normally. P had difficulty controlling aircraft under these IFR conditions, reporting that after he took control, "I wasn't holding it right. I was going into a turn everytime I had it straight on the attitude indicator." Aircraft went into high-speed dive, with AC relieving P at controls and restoring normal cruise speed and attitude. P decided instruments were not functioning properly. At about this time one of the crew members in rear of aircraft stated that he (the crew member) had vertigo. AC decided to abort mission and started tuning radios to request GCA clearance. AC stated, "I called GCA again, still receiving no answer. I called once more all the while having my head down to look at the UHF control head and to check the frequency given to me. When I looked up, the aircraft seemed to be in an unusual attitude, low on airspeed, and losing altitude. I took over control of the aircraft indicating to the P on the intercom. I felt he must have had a touch of vertigo. I soon found myself in apparent vertigo as I seemed unable to return the aircraft to normal flight . . . ." Soon thereafter, aircraft impacted ground. Board mention of AC possibly going into vertigo due to Coriolis effect produced by head motion at time he relieved P at controls. Board opinion was that P had vertigo throughout and that his instruments were functioning properly.

CASE BRIEF 69-26

Vietnam: combat mission--reconnaissance; flight phase--other; night flight; four persons aboard--four minor injuries; aircraft strike damage.

Fire team received tactical emergency message from ground unit in enemy contact. Since the involved fire team had been on standby, all aircraft had been preflighted several hours earlier. Lead aircraft made takeoff, raising considerable dust. Accident aircraft waited for dust to settle and then lifted to a hover to move toward runway. At this point, visibility started going IFR due to dust. As AC continued his movement, the searchlight went out. Both AC and P attempted to recycle switches, hoping to turn on landing light or searchlight. The dust became thicker, and AC started to lose control, with aircraft beginning to arc back and forth. AC said he had vertigo and P came on controls. Aircraft drifted backward and downward with right skid low. Tail boom hit ground, eventually resulting in a main rotor strike. AC stated, "I felt the aircraft begin moving backward and then forward. The only ground reference I had was when we were in the middle of the arc and the navigation lights showed the ground. We made about 3 or 4 arcs, forward and backward. I believe I had vertigo, anyway with the dust I couldn't keep ground reference . . . ."

CASE BRIEF 69-27

Vietnam: combat mission--command and control; flight phase--inflight; day flight; six persons aboard--two fatalities, and four major injuries; aircraft strike damage.

Due to bad weather conditions, aircraft flying at 100 feet, with ceiling estimated to be between 200 and 400 feet. As aircraft approached a ridgeline AC thought weather would be the same on the other side and thus initiated a slight climb. However, as soon as he crossed the ridge, the weather was seen to be completely IFR. AC, not in communication with P, then initiated a climbing left turn to avoid weather. However, visibility went IFR, and light rain with turbulence was encountered. During the turn AC noticed that the bank was getting steeper and steeper, the aircraft was beginning to descend, and the controls were becoming difficult to move. As they started to come out of the weather, AC observed a hill to the front, approximately 50 feet above the aircraft. AC stated, "As we came out of the cloud I attempted to bring the aircraft to a level attitude, however, the controls were becoming more difficult to move. At this time, I noticed a hill to my front . . . . Heading toward a large tree with the controls apparently frozen, I looked over and then realized that my pilot had frozen on the controls. I attempted to move the controls but was unable to do so and we hit the tree." IP who gave P in-country check ride stated "On faster maneuvers such as autorotations, P had a tendency to tighten up on the controls and had to be talked or helped through the maneuver." AC had flown 138 hours during the preceding 30 days.

CASE BRIEF 69-28

Vietnam: combat mission--support; flight phase--other; day flight; ten persons aboard--one fatality; one major injury, and eight minor injuries (including one in another aircraft); aircraft strike damage plus damage to two other aircraft of mission.

Four-ship troop insertion team made approach to dirt-road landing zone. First three ships landed safely, encountering heavy dust. Fourth ship modified approach slightly to clear a ground vehicle near touchdown point. AC came to a hover, with dust present but visibility adequate to see the number-three aircraft to his front. Soon thereafter, dust swirled upward through rotor blades, causing visibility to go completely IFR. Aircraft drifted forward, with rotor blades of number-three and number-four aircraft becoming enmeshed.

CASE BRIEF 69-29

Vietnam: combat mission--support; flight phase--other; day flight; four persons aboard--no injuries; aircraft strike damage.

Aircraft, cleared to land ahead of a flight of five aircraft, touched down far down runway to give flight landing room. As the aircraft terminated at a hover, light fire team on ground called tower for an immediate departure on a scramble mission. AC moved aircraft toward revetments, taking care to keep his spray boom clear of obstacles. Aircraft drifted, with rotor blades contacting parked aircraft.

CASE BRIEF 69-30

United States: mission--other; flight phase--other; day flight; one person aboard--no injuries.

Aircraft with single P aboard landed at an outlying range. P, sitting in right seat, lifted aircraft to a hover and initiated a turn to the left, using cyclic and left pedal. During turn, the left skid went low and contacted ground, resulting in a main rotor strike.

CASE BRIEF 69-31

Vietnam: combat mission--support; flight phase--takeoff; day flight; four persons aboard--no injuries.

AC, preparing for takeoff, lifted aircraft to a hover to check rotor rpm. Since rpm low, aircraft was set down to regain rotor velocity. This hover and set down sequence was repeated three times. When rpm finally adequate, AC initiated takeoff down paved highway. Translational lift had not been achieved when aircraft passed over end of paved surface and started raising ground dust. Visibility finally went IFR, and AC decided to abort flight. Aircraft drifted to the left and contacted nearby trees.

CASE BRIEF 69-32

Vietnam: training mission--proficiency; flight phase--other; day flight; two persons aboard--two minor injuries.

IP giving in-country check ride to new P demonstrated various maneuvers, including several autorotations. On a demonstration of a low-level autorotation, IP placed aircraft into an excessive flare which resulted in a tail rotor strike. IP did not sense that the aircraft attitude was unusual at any point within the flare.

CASE BRIEF 69-33

Vietnam: combat mission--assault; flight phase--other; day flight; four persons aboard--two minor injuries; aircraft strike damage.

Accident aircraft flying number-three position in a formation of six aircraft that were late on an assigned assault mission. Flight maintained 100 knots until one minute out from landing zone. Formation came to a high hover over a long series of dikes which ran at right angles to the flight path. While hovering forward toward touchdown point, aircraft drifted downward, with right skid contacting the top of a dike, causing aircraft to pitch forward and roll over on side. AC stated, "We were coming in on short final at about 4 feet when the aircraft seemed to just fall out of the sky."

CASE BRIEF 69-34

Vietnam: combat mission--support; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Group of eight aircraft made night flight to outlying field, landing at approximately 2230 hours. Crew of each aircraft set up rotating watch to guard individual ships during night. At approximately 0500 the crews were alerted and the flight cleared for takeoff at 0518. Flight departed in two groups of four. During climb out leader of first group noticed clouds and haze in direction of flight and initiated a right turn. As weather deteriorated, various aircraft within formation encountered difficulties due to IFR visibility. AC of aircraft flying number-two position in second group radioed, "I'm in trouble. Watch me.", as visibility went IFR. One aircraft in first group descended to the point that crew saw trees, with that AC making pullup at last minute. Crew of number-four ship in the second group later reported that they experienced vertigo while executing a turn to get out of weather. Aircraft number two of the second group seen to impact hillside during slow climbing turn, followed within seconds by aircraft number three. Board stated that neither the flight leader nor any AC of any ship within the flight issued a radio warning of the intermittent IFR weather conditions that were encountered during this period. AC of other aircraft in same flight mentioned communication problems during emergencies because of heavy traffic on channels. He stated, "We have C & C, the guns, the slicks, and cowboy control on the same frequency and when there is an emergency, it makes it almost impossible for anyone to hear you." Note that Case Brief 69-35 involves the same flight.

CASE BRIEF 69-35

Vietnam: combat mission--support; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

See Case Brief 69-34 for related details. Accident aircraft was flying the number-three position in the second group. Board reported that one of the two attitude indicators was known to be inoperative before the flight was initiated. AC had flown 143 hours during the preceding 30 days.

CASE BRIEF 69-36

Vietnam: combat mission--assault; flight phase--landing; day flight; eleven persons aboard--one minor injury.

Accident aircraft approaching touchdown area behind lead aircraft that had just landed. As aircraft approached area, dust raised by lead aircraft degraded visibility. AC continued approach, with visibility finally going completely IFR due to dust raised by both aircraft. Misjudged altitude and made a hard landing, resulting in extreme skid damage.

CASE BRIEF 69-37

United States: training mission--night landing; flight phase--landing; night flight; two persons aboard--two minor injuries; aircraft strike damage.

Students practicing night landings under low-level tactical lighting conditions. SP overshot intended touchdown point while drifting left. Struck ground in a slight nose-high attitude on heels of both skids, eventually resulting in a main rotor strike. SCP stated, "The SP airspeed was high and his approach became steep. I warned him that he would have to make a go-around if he didn't shallow out his approach. However, he continued on his same approach path. I could see he was overshooting the panel and was also drifting to the left. He apparently did not recognize his rate of closure and ground speed to be fast . . . ."

CASE BRIEF 69-38

United States: training mission--night gunnery; flight phase--inflight; night flight; four persons aboard--three fatalities and one major injury; aircraft strike damage.

Four-ship gunnery training flight with experienced IP aboard each aircraft. Two of the aircraft completed missions and returned to base while formation leader circled fourth ship which had landed to clear its armament prior to return trip. Formation leader climbed to 1000 feet, with weather rapidly deteriorating to heavy rain. IP of fourth aircraft made take-off into heavy rain, radioing flight leader that he was "right behind." Aircraft impacted trees shortly thereafter. Surviving passenger stated he observed "The gyro swinging all over the place, felt the pilot was disoriented." Also observed that heavy rain resulted in zero-zero visibility at time of takeoff.

CASE BRIEF 69-39

United States: training mission--night landings; flight phase--landing; night flight; three persons aboard--no injuries.

Accident aircraft was in the number-six position of a seven-ship formation making an approach to a field with low-level tactical illumination. Night was dark with no moon. As formation began to decelerate, IP warned SP to be careful of aircraft in immediate front. SP aircraft impacted ground, with left skid in a nose-low attitude. SP stated, "The approach went very well but it seemed to be on the shallow side to me, I couldn't really tell though. Number four was flaring and decelerating and I was staying right with him. Just before we contacted the ground it seemed that number four flared an excessive amount and I never had time to start a flare, although we seemed to be in good flare at the time . . . ." After flight IP stated that he had flown over 6 hours just prior to the time of the accident and was tired. Also mentioned his apprehension relative to night formation flights, with students having experienced a "near-miss" mid-air the previous week. IP of number-four aircraft stated that his student had similar difficulties on this same approach and had to be relieved at the controls.

CASE BRIEF 69-40

Vietnam: combat mission--assault; flight phase--landing; day flight; ten persons aboard--four minor injuries; aircraft strike damage.

Aircraft in sixth position of an eight-ship formation making a landing at a forward combat site. As AC terminated at a low hover, visibility went IFR due to rotor-raised ashes and dust. Aircraft set down, with right skid impacting ground first and ship rolled over on side. AC stated, "As I started lowering the collective, dust began to fly up everywhere. The first thing I noticed was that I lost my front windshield visibility. I looked down between my pedals and I could see the ground clearly. I kept lowering the collective and then I lost sight of the ground and my sense of direction -- I didn't know where I was or what attitude the helicopter was in and before I knew it, the right skid hit the ground."

CASE BRIEF 69-41

Vietnam: service mission--search and rescue; flight phase--inflight; night flight; six persons aboard--four fatalities and two minor injuries; aircraft strike damage.

Message received that a unit aircraft had experienced engine failure and autorotated into bay adjacent to field. P working in operations asked which aircraft was ready for rescue. Entered assigned aircraft and made takeoff without preflight and without a copilot. Climbed to 300 feet, with both the landing light and the searchlight turned on. P then initiated a descent to 200 feet since the water surface was not visible. Passenger in copilot seat stated he couldn't see the water because of a haze (highly probable that this "haze" was actually the aircraft lights reflecting off the water surface). After descending to 200 feet and leveling out, P initiated radio communications with tower. Aircraft observed to gradually descend into water. P had over 3000 hours' FW experience but only 179 RW hours.

CASE BRIEF 69-42

Vietnam: combat mission--resupply; flight phase--landing; day flight; nine persons aboard--one fatality.

Aircraft made three passes over landing area looking for optimal touchdown point. AC chose an area near a radar tower. As he began his descent on the fourth approach, visibility went IFR due to dust. AC decided to make a go-around when crew warned of proximity to radar tower. AC changed course and continued with his go-around. With visibility still IFR, aircraft descended slightly and impacted a small lookout tower.

CASE BRIEF 69-43

Vietnam: combat mission--support; flight phase--other; day flight; four persons aboard--no injuries.

AC lifted aircraft to hover and began backing out of revetment. Aircraft tail drifted low while backing, resulting in ground contact. Nose pitched up and tail boom struck the runway surface.

CASE BRIEF 69-44

Vietnam: combat mission--command and control; flight phase--landing; night flight; four persons aboard--no injuries; aircraft strike damage.

Crew performing a night mission under marginal weather conditions to support an outpost undergoing attack. Enroute to destination, weather deteriorated, with intermittent rain showers encountered. The approach and landing to the outpost were made without mishap, and the passengers for the perimeter were loaded on the aircraft. During takeoff, aircraft received ground fire but did not sustain any hits. Shortly thereafter, the aircraft was ordered to return. On the approach to the field, bordered by a lake, AC requested ground unit to fire mortar flares for illumination. Because of the severe weather, the pilots had to fly consistently on instruments since all reference to the horizon was lost whenever the mortar flares burned out. As aircraft arrived over the lake, all crew members saw the water and felt they were 200 to 300 feet above its surface. Light rain began to hit aircraft, and AC decided to make a go-around. At that instant, the aircraft struck the lake in a near-level attitude.

As mentioned in each of the earlier factors reports (refs. 3 and 6), even a hasty examination of these narrative data will drive home the often-stated point of accident researchers that, in general, no single factor is solely responsible for causing an accident. Though one factor or event may initiate or trigger the orientation error, other factors or events are usually present which act in combination to finally effect an accident rather than a simple incident or near-miss situation.

A selected listing of the various factors derived from the review of the master accident files for these accidents is presented in Figure 10 through 14 on an individual case history basis. Once again the reader is reminded that the listing of any factor or event for a given accident is limited by the amount of data actually contained in the related master accident jacket. The format used in the preparation of Figures 10 through 14 is keyed to the identification of factors and events on an individual accident basis. In each of these figures, a separate vertical column is assigned to each accident where the number at the top of each column corresponds to the accident number used to sequentially identify the individual case history briefs presented earlier. An alphanumeric index code is used to identify selected accident factors where an x-entry denotes the presence of the related factor. In addition to these individual listings, the total number of accidents in which a given factor was present is tabulated in a separate column. Reference should be made to the first report (ref. 3) of this series for details pertinent to the basic classification criteria used for the different factors.

Figure 10 summarizes various accident/aviator background information associated with these 44 accidents. The location of each accident is denoted in rows A1 through A3. For that fiscal year, 84.1 percent of the UH-1 orientation-error accidents occurred in Vietnam. As denoted by the A4-A8 entries, the greatest number (61.4 percent) of the accidents occurred in the H model of the UH-1. Rows A9-A13 indicate the mission assignment, rows A14-A17 the phase of flight in which the accident occurred, and rows A18 and A19 the time of day in terms of daylight or night visibility. Under the miscellaneous heading, A20 denotes those accidents in which one or more fatalities were involved. Row A21 indicates those fatal accidents in which all personnel aboard the aircraft were killed. Entries in row A22 indicate accidents resulting in a total loss or strike of the aircraft. In contradistinction, entries in A23 denote accidents resulting in minimal damage, i.e., the accidents in which the total dollar damage was less than $25,000, which amounts to approximately 10 percent or less of the replacement cost of the aircraft.

The B and C headings in Figure 10 give data relative to the background and experience of the first and second pilots, respectively. The interpretation of the experience data contained in rows B5-B9 and C5-C9 should be related to the data previously presented in Figures 7 and 8, which pertain to only total RW time and total UH-1 time. Rows B5 and C5 denote those aviators with both FW and RW military aircraft time who had a total FW and RW experience of 1000 hours or more. In terms of only RW flight time, entries B6 and C6 denote those aviators with 1000 hours or more of RW experience. In the opposite direction, entries B7 and C7 identify aviators with less than 400 hours RW time, denoting minimal experience. These RW data indicate that 15 (34.1 percent) of the 44 first pilots and 2 (5.0 percent) of the 40 second pilots were known to have had 1000 hours

FIGURE 10

MAJOR ORIENTATION-ERROR ACCIDENTS
- REGULAR ARMY UH-1 AIRCRAFT -

FY 69 — BACKGROUND DATA

ACCIDENT CASE NUMBER — O = DATA NOT AVAILABLE

CODE		TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	ACCIDENT BACKGROUND																															
1	LOCATION																															
1	Vietnam	37	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	
2	United States	6					X											X														X
3	Other	1																							X							
	AIRCRAFT MODEL																															
4	UH-1B	4														X																
5	UH-1C	7		X		X			X				X											X				X				
6	UH-1D	6	X		X		X																		X							X
7	UH-1H	27						X		X	X	X		X	X		X	X	X	X	X	X	X			X	X		X	X	X	
8	UH-1 other																															
	ASSIGNED MISSION																															
9	Training	8	X				X							X				X														
10	Service	5			X								X												X	X						
11	Test	2																		X				X								
12	Combat	28		X		X		X	X	X	X	X			X	X	X		X		X	X	X				X	X	X	X	X	
13	Other/unknown	1																														X
	ACCIDENT FLIGHT PHASE																															
14	Takeoff	3						X																X								
15	Inflight	14	X			X			X	X					X	X			X						X		X		X			
16	Landing	14			X						X		X				X	X			X	X				X						
17	Other	13		X			X					X		X						X			X					X		X	X	X
	TIME OF DAY																															
18	Daylight Accident	20	X	X							X			X					X		X		X		X	X			X	X	X	X
19	Night Accident	24			X	X	X	X	X	X		X	X		X	X	X	X		X		X		X			X	X				
	MISCELLANEOUS																															
20	Fatal Accident	16	X		X	X									X	X			X					X	X		X		X	X		
21	Fatal Injury: all aboard	5																	X					X	X							
22	Aircraft Damage: strike - total loss	30	X		X	X	X	X	X	X	X		X		X	X	X		X		X			X	X	X	X	X	X	X	X	
23	Aircraft Damage: less than $25,000	3																X														
B	1st PILOT BACKGROUND																															
1	Past Military FW Experience	4		X										X				X														
2	FW Instrument Ticket	4		X										X				X														
3	RW Instrument Ticket	37	X	X	X	X		X			X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	Not Instrument Rated	4					X		X	X																						
5	Total FW-RW Experience: greater than 1000 hours	6		X										X				X					X									
6	Total RW Experience: greater than 1000 hours	15		X		X		X	X		X			X						X											X	
7	Total RW Experience: less than 400 hours	5					X																									X
8	Total UH-1 Experience: greater than 500 hours	18	X	X		X		X	X	X	X	X	X			X									X				X		X	
9	Total UH-1 Experience: less than 100 hours	4					X											X						X								
10	Received Fatal Injury	7				X										X			X						X							
11	Involved in Previous/Later Accidents	11	X	X						X	X			X					X		X				X	X					X	
C	2nd PILOT BACKGROUND																															
1	Past Military FW Experience																															
2	FW Instrument Ticket																															
3	RW Instrument Ticket	37	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	
4	Not Instrument Rated	2					X																									
5	Total FW-RW Experience: greater than 1000 hours																															
6	Total RW Experience: greater than 1000 hours	2				X			X																							
7	Total RW Experience: less than 400 hours	25	X		X		X	X		X	X		X	X	X		X	X			X		X		X	X	X		X	X		
8	Total UH-1 Experience: greater than 500 hours	2				X			X																							
9	Total UH-1 Experience: less than 100 hours	15	X	X	X		X							O	X			X			X				X		O			X		
10	Received Fatal Injury	8	X													X			X						X				X			
11	Involved in Previous/Later Accidents	4						X	X																							
12	2nd Pilot Not Aboard	4																		X				X								X

CODE		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	ACCIDENT BACKGROUND																														
1	LOCATION																														
1	Vietnam	X	X	X	X	X	X				X	X	X	X	X																
2	United States							X	X	X																					
3	Other																														
	AIRCRAFT MODEL																														
4	UH-1B							X	X					X																	
5	UH-1C	X																													
6	UH-1D									X																					
7	UH-1H		X	X	X	X	X				X	X	X		X																
8	UH-1 other																														
	ASSIGNED MISSION																														
9	Training		X					X	X	X																					
10	Service											X																			
11	Test																														
12	Combat	X		X	X	X	X				X		X	X	X																
13	Other/unknown																														
	ACCIDENT FLIGHT PHASE																														
14	Takeoff	X																													
15	Inflight				X	X			X			X																			
16	Landing						X	X		X	X		X		X																
17	Other		X	X										X																	
	TIME OF DAY																														
18	Daylight Accident	X	X	X			X				X		X	X																	
19	Night Accident				X	X		X	X	X		X			X																
	MISCELLANEOUS																														
20	Fatal Accident				X	X			X			X	X																		
21	Fatal Injury: all aboard				X	X																									
22	Aircraft Damage: strike - total loss			X	X	X		X	X		X	X			X																
23	Aircraft Damage: less than $25,000						X							X																	
B	1st PILOT BACKGROUND																														
1	Past Military FW Experience		X																												
2	FW Instrument Ticket											X																			
3	RW Instrument Ticket	X	X		X	X	X		X	X	X		X	X	X																
4	Not Instrument Rated			X																											
5	Total FW-RW Experience: greater than 1000 hours		X									X																			
6	Total RW Experience: greater than 1000 hours	X	X	X					X	X			X		X																
7	Total RW Experience: less than 400 hours						X	X				X																			
8	Total UH-1 Experience: greater than 500 hours			X					X	X			X		X																
9	Total UH-1 Experience: less than 100 hours							X																							
10	Received Fatal Injury				X	X			X																						
11	Involved in Previous/Later Accidents		X																												
C	2nd PILOT BACKGROUND																														
1	Past Military FW Experience																														
2	FW Instrument Ticket																														
3	RW Instrument Ticket	X	X	X	X	X	X		X		X		X	X	X																
4	Not Instrument Rated									X																					
5	Total FW-RW Experience: greater than 1000 hours																														
6	Total RW Experience: greater than 1000 hours																														
7	Total RW Experience: less than 400 hours		X	X				X		X	X		X		X																
8	Total UH-1 Experience: greater than 500 hours								O																						
9	Total UH-1 Experience: less than 100 hours		X					X	O	X	X		O	X	X																
10	Received Fatal Injury				X	X			X																						
11	Involved in Previous/Later Accidents												X	X																	
12	2nd Pilot Not Aboard											X																			

Figure 10

Individual case history listing of basic accident details and selected aviator background information.

or more experience while 5 (11.4 percent) first pilots and 25 (62.5 percent) second pilots had less than 400 hours experience. However, considering the individual RW experience of each aviator, there were only two accidents (both involved students undergoing basic training) where both pilots were known to have had a total time of less than 400 hours.

Relative to total time in the UH-1 aircraft, entries B8 and C8 denote aviators with greater than 500 hours, while B9 and C9 denote those with less than 100 hours. These data indicate that 18 (40.9 percent) first pilots and 2 (5.0 percent) second pilots were known to have 500 hours or more. There were 4 (9.1 percent) first pilots and 15 (37.5 percent) second pilots with less than 100 hours experience in the UH-1 aircraft. Only 3 flights, all training related, involved the situation where neither pilot had 100 hours or more of UH-1 flight time. Entries B2-B4 and C2-C4 pertain to the instrument ratings of the aviators. These data indicate that there were only 4 first pilots and 2 second pilots who did not possess some form of instrument rating. Except for 2 training accidents, all flights had at least one instrument-rated pilot aboard the aircraft.

To gain insight into the availability of post-flight data from the aviators involved in the accident, entries B10 and C10 indicate those pilots fatally injured. Data pertaining to other accidents the pilots may have been involved in are listed in entries B11 and C11. For that fiscal year, 11 (25.0 percent) first pilots and 4 (10.0 percent) second pilots were involved in one or more additional accidents that occurred either before or after the accident under discussion. Fifteen accidents (34.1 percent) involved the situation where at least one pilot aboard the aircraft had a pre- or post-accident record.

The factor and event data presented in Figures 11 through 14 follow the Figure 10 format with the row entries continuing to be identified in alphanumeric sequence. It should be observed that Figures 11 and 12 are concerned with factors and events which were found to be present, or to have happened, in the time period preceding takeoff; Figures 13 and 14 list factors and events which occurred, so far as the crew were concerned, only after the aircraft became airborne. This approach has been selected with the long-term objective of possibly distinguishing between accidents that may occur as a result of initial conditions existing before flight, and accidents that may occur seemingly as a result of only some inflight event or factor.

In Figures 11 and 12, factors and events which were present before takeoff are listed under physiological, psychological, facility, supervisory, materiel, mission pressure, pilot preflight, and miscellaneous factor headings. The D and F headings pertain to physiological and psychological factors, respectively, associated with the first pilot while the E and G headings list the same factors for the second pilot. This separate listing allows a heavier weighting to be given these factors when both pilots, rather than only one, experience the related difficulties.

Relative to physiological problems that existed prior to takeoff, fatigue was found to be the most obvious factor. Four entries, D1-D4 for the first pilot and E1-E4 for the second pilot have been allotted to the description of this problem. Entries D1 and E1 denote aviators with greater than 140 total flight hours during the 30 days preceding

FIGURE 11

MAJOR ORIENTATION-ERROR ACCIDENTS – REGULAR ARMY UH-1 AIRCRAFT –

FY69 FACTORS / EVENTS — BEFORE TAKEOFF

ACCIDENT CASE NUMBER (cases 1–30)

CODE	Factor	TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	PHYSIOLOGICAL FACTOR – 1st PILOT																															
1	Fatigue: 140 hours or more last 30 days	3									X								X													
2	Fatigue: between 90 and 140 hours last 30 days	10	X		X															X	X								X	X	X	
3	Fatigue: 8 hours or more last 24 hours	7			X										X						X					X					X	
4	Fatigue: other	3																						X								
5	Missed Meals	1			X																											
6	Degraded Night Vision																															
7	Other																															
E	PHYSIOLOGICAL FACTOR – 2nd PILOT																															
1	Fatigue: 140 hours or more last 30 days																															
2	Fatigue: between 90 and 140 hours last 30 days	6				X			X		X		X						X												X	
3	Fatigue: 8 hours or more last 24 hours	2			X																					X						
4	Fatigue: other	1																														
5	Missed Meals	1			X																											
6	Degraded Night Vision																															
7	Other																															
F	PSYCHOLOGICAL FACTOR – 1st PILOT																															
1	Apprehension	1																														
2	Anger/Irritation: crew dissension																															
3	Anger/Irritation: other																															
4	Personal Problems																															
5	Other	2																														
G	PSYCHOLOGICAL FACTOR – 2nd PILOT																															
1	Apprehension																															
2	Anger/Irritation: crew dissension																															
3	Anger/Irritation: other																															
4	Personal Problems																															
5	Other	1																											X			
H	FACILITY FACTOR																															
1	Field Lighting																															
2	Field Dust Control																															
3	Ground Handling Services																															
4	Other																															
I	SUPERVISORY FACTOR: Responsibility																															
1	Aircraft Commander or 1st Pilot																															
2	Flight/Formation Leader																															
3	Air Unit Commander	10			X										X			X		X				X		X						
4	Ground Unit Commander																															
5	Facility Commander	1																X														
6	Other Individual																															

ACCIDENT CASE NUMBER (cases 31–60)

CODE	Factor	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
D	PHYSIOLOGICAL FACTOR – 1st PILOT																														
1	Fatigue: 140 hours or more last 30 days					X																									
2	Fatigue: between 90 and 140 hours last 30 days			X			X								X																
3	Fatigue: 8 hours or more last 24 hours				X	X																									
4	Fatigue: other				X					X																					
5	Missed Meals																														
6	Degraded Night Vision																														
7	Other																														
E	PHYSIOLOGICAL FACTOR – 2nd PILOT																														
1	Fatigue: 140 hours or more last 30 days																														
2	Fatigue: between 90 and 140 hours last 30 days																														
3	Fatigue: 8 hours or more last 24 hours																														
4	Fatigue: other				X																										
5	Missed Meals																														
6	Degraded Night Vision																														
7	Other																														
F	PSYCHOLOGICAL FACTOR – 1st PILOT																														
1	Apprehension									X																					
2	Anger/Irritation: crew dissension																														
3	Anger/Irritation: other																														
4	Personal Problems																														
5	Other							X				X																			
G	PSYCHOLOGICAL FACTOR – 2nd PILOT																														
1	Apprehension																														
2	Anger/Irritation: crew dissension																														
3	Anger/Irritation: other																														
4	Personal Problems																														
5	Other																														
H	FACILITY FACTOR																														
1	Field Lighting																														
2	Field Dust Control																														
3	Ground Handling Services																														
4	Other																														
I	SUPERVISORY FACTOR: Responsibility																														
1	Aircraft Commander or 1st Pilot																														
2	Flight/Formation Leader																														
3	Air Unit Commander	X			X	X					X																				
4	Ground Unit Commander																														
5	Facility Commander																														
6	Other Individual																														

Figure 11

Individual case history listing of selected accident factors and events present before, or at the instant of, takeoff on the accident flight. See text for details.

CODE	FIGURE 12 MAJOR ORIENTATION-ERROR ACCIDENTS - REGULAR ARMY UH-1 AIRCRAFT -	TOTAL	FY 69 FACTORS / EVENTS — BEFORE TAKEOFF ACCIDENT CASE NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
J	MATERIEL FACTORS		
1	Aircraft Engine System		
2	Flight Controls		
3	Flight Instruments	1	×35
4	Communication Gear		
5	Navigation/Landing/Search Lights		
6	Windshield Wipers		
7	Other		
K	MISSION PRESSURE FACTORS		
1	Urgent Mission: med evac - search and rescue	6	×8 ×15 ×17 ×20 ×25 ×41
2	Urgent Mission: other	4	×6 ×7 ×26 ×44
3	Firefly Mission	1	×13
4	1st of a Kind Assignment	1	×1
5	Other		
L	PILOT PREFLIGHT FACTORS		
1	Hurried/Rushed Preflight	1	×41
2	Knowingly Accepted Deficient Aircraft	1	×35
3	Unknowingly Accepted Deficient Aircraft		
4	Inadequate Power/RPM Check	1	×31
5	Other	3	×2 ×6 ×8
M	MISCELLANEOUS FACTORS/EVENTS		
1	No Copilot Aboard	4	×18 ×23 ×30 ×41
2	Pilot Only Person Aboard	1	×30
3	Marginal Aircraft Weight	2	×24 ×31
4	Hurried Departure	2	×26 ×41
5	Delayed Departure		
6	Other		

Figure 12

Continuation of the Figure 11 listing of before-takeoff factors and events.

the accident. Army regulations for Vietnam flight operations set this figure as the upper limit which cannot be exceeded except during tactical emergencies. Although it is possible to obtain permissiom at the battalion level to exceed this limit, the regulations direct the Commanders to use the utmost discretion when granting this waiver. For fiscal year 1969, there were three accidents in which at least one pilot had flown more than 140 flight hours during the preceding 30 days. The same Army regulations also state that a crew member who accumulates 90 hours in a 30-day period will be closely monitored by the unit commander and the flight surgeon. This monitoring requirement is thus an implied recognition of individual susceptibility to fatigue. For this reason, the authors have chosen also to identify those accidents involving aviators with a work-load greater than 90 hours, and less than 140 hours, during the preceding 30 days. The related D2 and E2 fatigue entries indicate 10 first pilots and 6 second pilots experienced this work-load. There were 16 (36.4 percent) accidents in which either one or both of the aviators had flown more than 90 hours during the 30-day period preceding the accident. Of this total, 3 accidents involved the case where both aviators had flown more than 90 hours during the preceding 30 days.

A third fatigue classification, D3 and E3, involves the identification of aviators who had flown 8 hours or more the 24 hours preceding the accident. Seven first pilots and 2 second pilots experienced this workload. In entries D4 and E4, miscellaneous fatigue factors mentioned by the accident board, for example, long duty hours or interrupted sleep, are listed. Treating the four fatigue entries as a group, there were 21 (47.7 percent) accidents in which at least one aviator was exposed to one or more of the stated fatigue listings.

The F and G psychological factor listings are intended to identify any unusual mental condition or attitude that existed before the aircraft actually became airborne. With all F and G headings treated together, there were only 4 (9.1 percent) accidents in which one or more of the listed psychological factors were coded as present. It is the opinion of the authors at this point in the analysis that the field accident investigation teams seem in general to be reluctant to enter psychological-related information into the written record.

The H facility factor heading is used to denote any airfield shortcomings which the accident board considered to have some effect on either the accident proper or the course of flight action available to the pilot. The facility factors listed under this heading, distinct from those listed under the P heading in Figure 13, relate to shortcomings present before actual takeoff of the aircraft. No accidents were coded under this heading for fiscal year 1969.

Factor I deals with supervisory errors which were considered by the accident board to have taken place before the flight became airborne. The listings under this heading denote the individuals assigned primary responsibility for the error. A supervisory factor before takeoff was involved in a total of 10 (22.7 percent) accidents.

Materiel deficiencies that existed before takeoff are listed under the J heading in Figure 12. The function here is to identify the accident situation where a materiel factor was known to be present, but not necessarily known to the aviators, before the aircraft became airborne. These factors are distinguished from the materiel failures that may have occurred while inflight and are listed under the R heading in Figure 13. It should be observed that an entry in one of the J listings does not imply that the materiel deficiency necessarily affected or effected the accident. The only implication is that there was some difficulty associated with the listed materiel item. For that fiscal year, only one accident involved such a preflight materiel factor entry.

The K mission pressure heading is included as a preflight factor in an attempt to weight the crews' concept of the importance, the uniqueness, or the urgency of the mission. Though such a stress factor could be properly listed under the psychological heading, a separate listing is provided to distinguish among various operational situations. Taking into account all of the K factors, 12 (27.3 percent) accidents involved one or more of these mission pressure listings.

Section L deals with the crew preflight of the aircraft. The L1 entry denotes a hurried or rushed preflight situation, and as noted previously, entries L2 and L3 indicate the pilots knowledge of any materiel problems that existed prior to takeoff. The objective here is to establish different factor weights for the situation where the pilot knows in advance that his aircraft is not fully operational, and for the situation where this operational deficiency is not recognized until after the flight becomes airborne. The section M heading is reserved for miscellaneous factors, events, or conditions that may have been present at the time of or before takeoff.

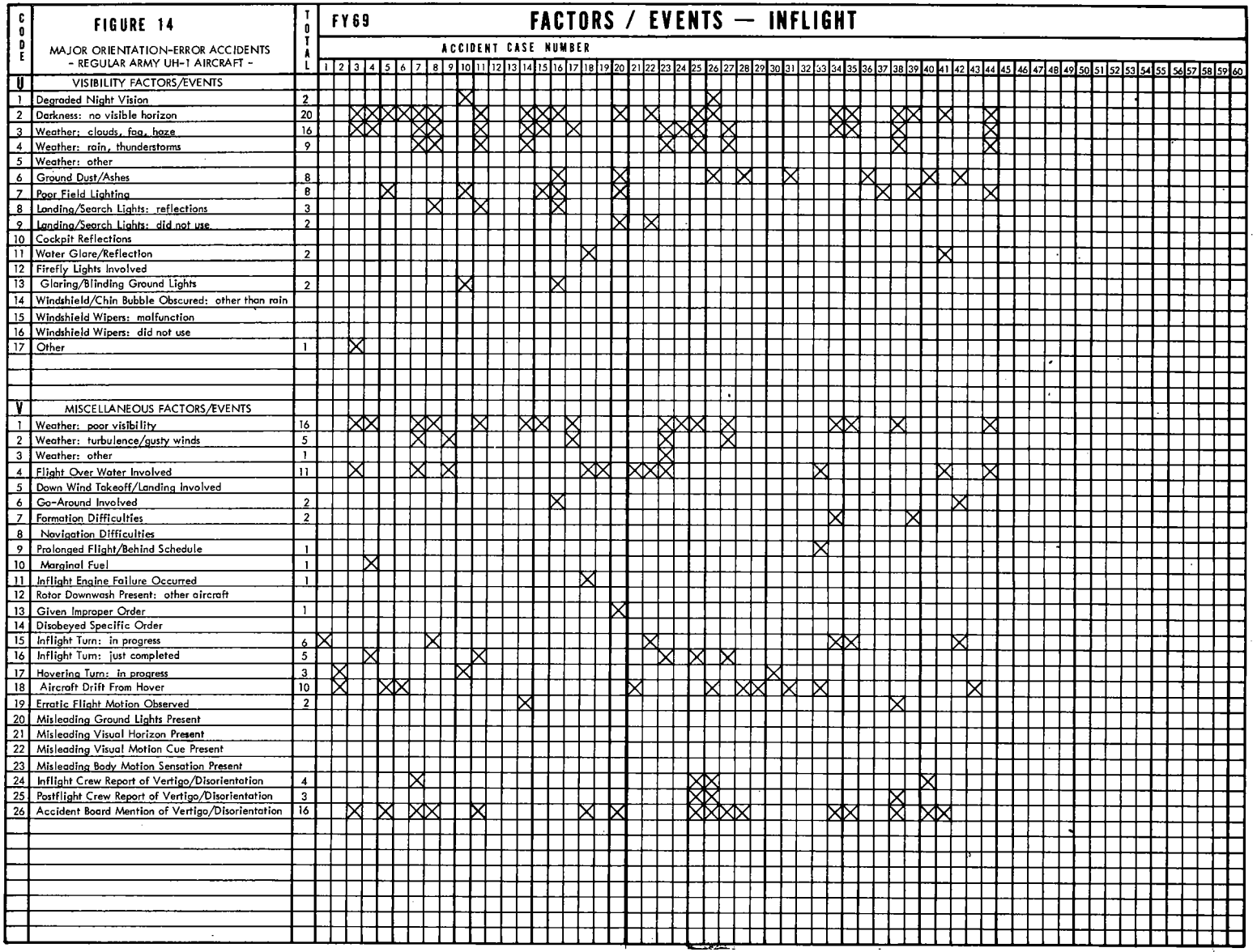
Factors similar to those in Figures 11 and 12 are outlined in Figures 13 and 14 but apply to the inflight phase of the 44 accidents. The N physiological factors and O psychological factor headings pertain to either pilot in this section since the accident review indicated that, in general, the inflight occurrence of such factors affected both pilots. The only physiological incident detected to occur inflight, other than the basic orientation-error event, involved night flights where some form of degraded night vision was highly probable. As indicated by the N1 entry, only 2 of the accidents involved this factor. The main criterion used in classifying this as a factor was that the crew had to be exposed to some form of high intensity illumination that was turned off shortly before the accident.

Section O is a listing of psychological factors that were coded as occurring inflight. This factor was coded as present in 7 (15.9 percent) of the accidents. A point of consideration relative to the total number of listings contained under the inflight psychological factors heading is that all the nonnormal incidents and events that occur inflight, whether they involve some materiel problem, some communication difficulty, or some change in visibility, can certainly affect the mental outlook of the crew. In this respect, the majority of the factors listed under all the other headings will have some psychological input.

CODE	FIGURE 13 MAJOR ORIENTATION-ERROR ACCIDENTS - REGULAR ARMY UH-1 AIRCRAFT -	TOTAL	FY69 FACTORS / EVENTS — INFLIGHT ACCIDENT CASE NUMBER (1–60): cases marked X
N	PHYSIOLOGICAL FACTOR - Either Pilot		
1	Degraded Night Vision	2	10, 26
2	Other		
O	PSYCHOLOGICAL FACTOR - Either Pilot		
1	Apprehension		
2	Irritation		
3	Reached Panic State		
4	Other	7	4, 16, 19, 23, 27, 39, 44
P	FACILITY FACTOR		
1	Field Lighting	1	10
2	Field Dust Control	5	16, 20, 26, 36, 42
3	Ground Handling Services	1	20
4	Other	6	6, 9, 10, 28, 29, 37
Q	SUPERVISORY: Responsibility		
1	Aircraft Commander or 1st Pilot	4	7, 28, 34, 35
2	Flight/Formation Leader	5	7, 16, 28, 36, 38
3	Air Unit Commander		
4	Ground Unit Commander		
5	Facility Commander	2	29, 37
6	Other Individual		
R	MATERIEL FACTOR		
1	Engine Malfunction/Failure	1	18
2	Flight Controls		
3	Flight Instruments		
4	Communication Gear		
5	Navigation/Landing/Search Lights	2	5, 26
6	Windshield Wipers		
7	Other		
S	COMMUNICATION FACTOR: Nonmateriel		
1	Wrong Frequency Used/Assigned		
2	Voice Procedures		
3	Language Difficulties	1	15
4	Other	8	8, 20, 21, 25, 29, 34, 35, 42
T	SPECIAL DISTRACTING EVENTS		
1	Nearby Combat Action	1	44
2	Danger of Mid-Air		
3	Other	9	9, 10, 13, 16, 21, 25, 26, 28, 29

Figure 13

Individual case history listing of selected accident factors and events considered to have occurred, or to be first manifested to the crew, while the aircraft was inflight.



CODE	FIGURE 14 MAJOR ORIENTATION-ERROR ACCIDENTS - REGULAR ARMY UH-1 AIRCRAFT -	TOTAL	FY69 FACTORS / EVENTS — INFLIGHT ACCIDENT CASE NUMBER 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
U	VISIBILITY FACTORS/EVENTS		
1	Degraded Night Vision	2	
2	Darkness: no visible horizon	20	
3	Weather: clouds, fog, haze	16	
4	Weather: rain, thunderstorms	9	
5	Weather: other		
6	Ground Dust/Ashes	8	
7	Poor Field Lighting	8	
8	Landing/Search Lights: reflections	3	
9	Landing/Search Lights: did not use	2	
10	Cockpit Reflections		
11	Water Glare/Reflection	2	
12	Firefly Lights Involved		
13	Glaring/Blinding Ground Lights	2	
14	Windshield/Chin Bubble Obscured: other than rain		
15	Windshield Wipers: malfunction		
16	Windshield Wipers: did not use		
17	Other	1	
V	MISCELLANEOUS FACTORS/EVENTS		
1	Weather: poor visibility	16	
2	Weather: turbulence/gusty winds	5	
3	Weather: other	1	
4	Flight Over Water Involved	11	
5	Down Wind Takeoff/Landing Involved		
6	Go-Around Involved	2	
7	Formation Difficulties	2	
8	Navigation Difficulties		
9	Prolonged Flight/Behind Schedule	1	
10	Marginal Fuel	1	
11	Inflight Engine Failure Occurred	1	
12	Rotor Downwash Present: other aircraft		
13	Given Improper Order	1	
14	Disobeyed Specific Order		
15	Inflight Turn: in progress	6	
16	Inflight Turn: just completed	5	
17	Hovering Turn: in progress	3	
18	Aircraft Drift From Hover	10	
19	Erratic Flight Motion Observed	2	
20	Misleading Ground Lights Present		
21	Misleading Visual Horizon Present		
22	Misleading Visual Motion Cue Present		
23	Misleading Body Motion Sensation Present		
24	Inflight Crew Report of Vertigo/Disorientation	4	
25	Postflight Crew Report of Vertigo/Disorientation	3	
26	Accident Board Mention of Vertigo/Disorientation	16	

Figure 14

Continuation of the Figure 13 listing of inflight factors and events.

The P facility factor heading denotes airfield shortcomings or limitations that affected the accident proper, or the course of action available to the pilot, while the flight was airborne. Though certain of these facility factors involved field sites rather than established heliports, it was the opinion of the accident board that it was reasonable to expect that the specific difficulty could have been prevented. In total, 11 (25.0 percent) accidents involved the P facility factor.

Personnel responsible for inflight-related supervisory errors are denoted under the Q heading. In total, the accident boards classified inflight supervisory error as being present in 9 (20.4 percent) of the cases.

Section R deals with materiel malfunctions or difficulties that were encountered while the flight was airborne. Materiel malfunctions outlined previously in the before-takeoff phase under the J heading are not entered here unless an attempt was made to use the defective materiel item while inflight. Inflight materiel difficulties were listed as present in only 3 (6.8 percent) of the accidents.

Section S describes inflight communication factors that were nonmateriel related. This factor was present in 9 (20.4 percent) accidents. Section T deals with special distracting events that the pilots encountered while airborne. This factor was listed in 10 (22.7 percent) accidents.

Section U deals with the key initiating factor in orientation-error accidents -- pilot visibility. In 32 (72.7 percent) of the 44 accidents, degraded visibility in one form or another was involved inflight. In 20 of the 24 night accidents, visibility was sufficiently low due to darkness proper, weather, or some other factor, that a visual horizon for orientation reference was not available. Decreased visibility due to weather in the form of clouds, fog, haze, rain, or snow was present in 16 of the accidents. Rain proper was present in 9 of these accidents.

A variety of miscellaneous factors and events related to the accidents are listed in section V. A breakdown of weather relative to visibility and nonvisibility factors is given in V1 through V3. It should be noted that only 5 of the cases involved turbulence or gusty winds. Entries V4 through V14 are self-explanatory. The V15 through V18 entries are the start of a compilation of data pertaining to the motion of the aircraft immediately preceding the accident. In 6 of the cases, an inflight turn was in progress at the time of the accident. Five additional cases involved the very recent completion of an inflight turn. In the case of hovering aircraft, 3 accidents occurred during a hovering turn. Ten accidents involved the sideward or backward drift of the aircraft while hovering.

Entry V19, the observation of erratic flight motion, is included to provide additional background data on control or orientation difficulties while inflight. Entries V20 through V23 pertain to any misleading sensations or illusions reported in the accident files. The V24 entries indicate that in 4 accidents, the crews recognized, while inflight, that they were experiencing orientation error manifested classically as vertigo or disorientation. As shown by V26, the accident investigation teams or reviewing authorities made specific

mention of either pilot vertigo or pilot disorientation in 16 (36.4 percent) of the 44 orientation-error accidents.

As has been stated before, this longitudinal study is aimed at the compilation of accident factor data over a five year period. Discussion or interpretation of these data beyond the above will await the assimilation of additional data for subsequent fiscal years.

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13. ABSTRACT

This report is the third in a longitudinal series of reports dealing with the pilot disorientation/vertigo problem in Regular Army UH-1 helicopter operations. Individual case history data extracted from the USABAAR master aircraft accident files are presented on 44 major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1969. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the cases. The listings are arranged to distinguish between those factors and events present before takeoff, i.e., the initial conditions associated with a given accident, and those which occurred or were manifested during the actual airborne phase of the accident flight.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Army aviation						
UH-1 helicopters						
Aircraft accidents						
Aviation safety						
Aviation medicine						
Pilot disorientation						
Vertigo						
Accident factors						