UNCLASSIFIED

Defense Technical Information Center
Compilation Part Notice

ADP013867

TITLE: Use of Simulator Spatial Disorientation Awareness Training Scenarios by the U.S. Army and National Guard

DISTRIBUTION: Approved for public release, distribution unlimited
Availability: Hard copy only.

This paper is part of the following report:

TITLE: Spatial Disorientation in Military Vehicles: Causes, Consequences and Cures [Desorientation spaiale dans les vehicules militaires: causes, consequences et remedes]

To order the complete compilation report, use: ADA413343

The component part is provided here to allow users access to individually authored sections of proceedings, annals, symposia, etc. However, the component should be considered within the context of the overall compilation report and not as a stand-alone technical report.

The following component part numbers comprise the compilation report:
ADP013843 thru ADP013888

UNCLASSIFIED

Use of Simulator Spatial Disorientation Awareness Training Scenarios by the U.S. Army and National Guard

Mr. Arthur Estrada, Dr./Captain Gina E. Adam and Dr. Patricia A. Leduc
USAARL
Building 6901
Fort Rucker, AL 36362-0577
USA

Summary

Every year the U.S. Army loses aviation assets due to spatial disorientation (SD). All aircrew members, regardless of flight experience, are vulnerable to SD. Despite academic training and new technologies, SD accident rates are not improving. In 1997, the United States Army Aeromedical Research Laboratory (USAARL) developed a method of simulator training to provide experience with factors leading to potentially disorienting events. Actual SD accident summaries were reviewed and those accidents which could reasonably be replicated in a visual flight simulator were selected for the training scenarios. The published scenarios were distributed and were available for use by units on a voluntary basis for three years. Although touted as excellent by Army aviation leaders, this training is not required at any aviator training level. The primary purpose of the study was to determine the extent to which the USAARL SD awareness scenarios are used and are thought to benefit those receiving the training, and whether there is a desire to make the scenarios mandatory in aviators' annual simulator training requirements. A survey evaluating aviator SD experiences, and knowledge, use and opinions of the scenarios was distributed to U.S. Army/National Guard (NG) aviation units worldwide. The responses were used to produce descriptive statistics to determine relationships between flight experience levels and SD experience, experience levels/duty positions and exposure to SD scenario training, and to ultimately determine the level of acceptance of the USAARL SD awareness scenarios in the U.S. Army/NG. The findings revealed that the National Guard has been more aggressive in its voluntary integration of this training than the active Army. A majority of the sample having experience with the USAARL SD awareness scenarios had a positive opinion of the training indicating that it has 1) better prepared them to recognize factors which make SD more likely, 2) improved decision-making skills, 3) improved overall situational awareness and crew coordination skills, and that 4) all aviators would benefit from the training. With the apparent support for such training, aviation leaders could implement a training program with minimal effort. The research revealed that the majority of U.S. Army/NG aggregate has not been trained using the simulator scenarios. Apparently, without specific guidance and a regulatory requirement, simulator SD awareness training will not be conducted extensively. Without active advocation, what appears to be an effective means to mitigate the SD hazard will continue to be overlooked, and SD will continue to take its toll on the aviation community.

Introduction

Spatial disorientation occurs ". . . when the aviator fails to sense correctly the position, motion, or attitude of his aircraft or of himself within the fixed coordinate system provided by the surface of the earth and gravitational vertical" (Benson, 1978). SD remains an important source of attrition in military flying. U.S. Army Field Manual 3-04.301 (Headquarters, Department of the Army, 2000), Aeromedical Training for Flight Personnel, states that, "Spatial disorientation contributes more to aircraft accidents than any other physiological problem in flight." Regardless of their flight time or experience, all aircrew members are vulnerable to SD. According to the U.S. Army Safety Center (USASC) accident files and a report published

Paper presented at the RTO HFM Symposium on "Spatial Disorientation in Military Vehicles: Causes, Consequences and Cures", held in La Coruña, Spain, 15-17 April 2002, and published in RTO-MP-086.

by the U.S. Army Aeromedical Research Laboratory (Braithwaite et al., 1997), SD was considered to be a significant factor in 291 (30 percent) of Class A, B and C helicopter accidents in the U.S. Army between 1987 and 1995. According to the report, during this time, 110 lives were lost and a cost of nearly $468 million was incurred. The monetary cost of SD is high and the fatality rate is between one and one-half to two times that of nondisorientation accidents.

One of the means of reducing the impact of SD may be through enhanced awareness and training of aviators. While aviators may have had some experience in recovering from unusual attitudes during initial entry flight training, it is not possible to demonstrate many of the disorienting circumstances safely during actual flight. It can, however, be safely and effectively demonstrated in a visual flight simulator.

Simulator flight scenarios were developed (Estrada et al., 1998) in support of a USAARL research protocol for the assessment of using simulated spatial disorientation scenarios in training U.S. Army aviators. Actual SD accident summaries from the USASC were reviewed and those accidents which could reasonably be replicated in a visual flight simulator were selected for the development of the simulator scenarios.

A study was then conducted to assess the feasibility of using visual flight simulator scenarios to train aviators to recognize, avoid, and overcome SD. The study, completed in 1997 and published as USAARL Report No. 2000-06, revealed the potential benefits of utilizing helicopter visual flight simulators in the process of increasing pilot awareness of the hazards of SD. The research data collected indicated a very favorable response to this method of training. The result was that aviators receiving the SD scenario training increased their situational awareness of the conditions and events that lead to SD. In addition, the scenarios provided training to assist aviators in overcoming SD once it was encountered. Other, yet equal, benefits from this method of training were found to be the reinforcement of aircrew coordination and the development of decision-making, risk assessment, and judgement skills.

Background

The collection of simulator training scenarios was published as USAARL Report No. 98-17 in January of 1998. Following its publication, the report was, and continues to be, widely distributed and has been positively received by the aviation training community. Currently, the scenarios are touted to the attendees of the U.S. Army Aviation Center's Aviation Division Commander's Course and the Brigade/Battalion Pre-Command Course to demonstrate to future aviation commanders the accident prevention potential of such simulated training. Presently, the Eastern Army National Guard Aviation Training Site (EAATS) mandates, by standing operating procedures (SOPs), training in the use of the USAARL-developed scenarios. The Western Army National Guard Aviation Training Site (WAATS) uses the scenarios during aviator refresher training. The active army, however, has chosen to promote the scenarios on a voluntary basis only, leaving their use to the discretion of the unit commander or unit instructor pilots.

In a presentation at the November 2000, "Recent Trends in Spatial Disorientation Research" Conference, held in San Antonio, Texas, a USAARL research psychologist stated that the preliminary results of a review of SD accidents for fiscal years (FY) 1996 through 2000 are similar to the reviews by Durnford et al. (1995) and Braithwaite et al. (1997). It was further stated that data comparison with FY's 1991 through 1995 showed that the SD accident rate is not decreasing, and if anything, since 1995, has slowly started increasing. This trend indicates that despite the best efforts of the USASC to educate the aviator through printed accident reviews and the efforts of the developers of better aircraft orienting technology (cockpit head-up displays, improved night vision devices, global positioning navigation systems, etc.), there has been little change in the SD accident rate.

Current study

The purpose of this study was to determine the demographics of Army aviators and civilian simulator instructor/operators who use, have used, or do not use the USAARL SD awareness training scenarios as part of their annual simulator training requirements. Particular emphasis was placed on whether the SD awareness training scenarios, after having been available for use by U.S. Army and National Guard aviation units for three years, actually have been used by units to improve their aviators' ability to recognize those factors that lead to spatially disorienting situations. Another goal was to determine, in the opinion of the aviators and civilian simulator instructor/operators who have used them, whether the scenarios have improved their crew coordination skills and increased their general situational awareness.

The following research question is addressed in this study: In the opinion of Army aviators and civilian simulator instructor/operators, should simulator SD awareness training scenarios become a mandatory part of the U.S. Army Aircrew Training Program (ATP)? The outcome of the study could change the current Army simulator training requirements, making the use of SD awareness scenarios mandatory.

It is important to note that this study was limited to a percentage of the total U.S. Army and National Guard aviators and civilian simulator instructor/operators. The analysis of data, implications, conclusions, and recommendations resulting from this study were applicable only to the population from which the sample was taken (Hencshel, 2000).

The following assumptions were made: 1. It was assumed that the population of survey respondents was adequate to serve as a sample representation of all U.S. Army and National Guard aviators and civilian instructor/operators; 2. It was assumed that all personnel surveyed answered all of the survey questions honestly.

Definition of terms

The following terms are defined for clarity and understanding:
Aircrew Coordination: A set of principles, attitudes, procedures and techniques that transforms individuals into an effective crew (Headquarters, Department of the Army, 1996).
Aircrew Training Program: A program of individual and crew training established by an Army aviation unit commander which standardizes training and evaluation to ensure combat readiness.
Army Aviator: A qualified aviator who is a current member of the active Army or National Guard.
Civilian Instructor/Operator: A Department of the Army civilian (DAC) or civilian contractor employed as an instructor and/or operator of an aircraft simulator.
Class A accident: An Army accident in which the resulting total cost of property damage is $1,000,000 or more; an aircraft or missile is destroyed, missing, or abandoned; or an injury and/or occupational illness results in a fatality or permanent total disability (Headquarters, Department of the Army, 1994).
Class B accident: An Army accident in which the resulting total cost of property damage is $200,000 or more, but less than $1,000,000; an injury and/or occupational illness results in permanent partial disability, or when five or more personnel are hospitalized as inpatients as the result of a single occurrence (Headquarters, Department of the Army, 1994).
Class C accident: An Army accident in which the resulting total cost of property damage is $10,000 or more, but less than $200,000; a nonfatal injury that causes any loss of time from work beyond the day or shift on which it occurred; or a nonfatal occupational illness that causes loss of time from work (for example, 1 work day) or disability at any time (lost time case) (Headquarters, Department of the Army, 1994).
Flight Activity Categories (FAC): FAC's (1,2,3) are designated by a commander based on the proficiency required by a particular aviator in a specific job or position. FAC levels are significant in that they mandate a minimum annual simulator hourly requirement for an aviator (Headquarters, Department of the Army, 1996).
IMC (instrument meteorological conditions): Meteorological conditions expressed in terms of visibility whereas reference to aircraft instruments is required to maintain the aircraft's attitude, position and/or track.

Night (unaided): Condition of flight between official sunset and sunrise during which night vision goggles are not utilized.
NVG (night vision goggles): Condition of flight between official sunset and sunrise during which night vision goggles are utilized.
Readiness Levels (RL): RL's (1,2,3) are the levels of an aviator's proficiency to perform the unit's mission. An RL1 aviator is ready to perform a combat mission, whereas an RL3 has yet to demonstrate proficiency in basic flight tasks (Headquarters, Department of the Army, 1996).
Refresher Training: Training required by an aviator (RL3) if he or she has not flown within the previous 180 days or has failed to demonstrate proficiency in a basic (base) flight task (Headquarters, Department of the Army, 1996).
USAARL: The United States Army Aeromedical Research Laboratory conducts research to prevent or minimize health hazards in the military operational environment and to sustain the aviator's individual performance.
USAAVNC: The United States Army Aviation Center is responsible for training military, civilian and international personnel in aviation and leadership skills.
USASC: The United States Army Safety Center is responsible for conducting accident investigations on Class A and selected Class B aviation accidents. The Safety Center maintains a database of all Army accidents.
Visual Flight Simulator: A helicopter simulator with the capability to produce a moving, outside visual scene.
VMC (visual meteorological conditions): Meteorological conditions expressed in terms of visibility whereas reference to aircraft instruments is not required to maintain the aircraft's attitude, position and/or track.

Review of relevant literature and research

A search and review of international spatial disorientation awareness training literature and research revealed that visual flight simulators are not reportedly used to train aviators in SD awareness. In fact, all North Atlantic Treaty Organization (NATO) countries rely heavily on academic training and a ride in a rotating chair, commonly called the Barany chair, to increase their undergraduate aviators' awareness of the potential for SD during flight. According to NATO Standardization Agreement (STANAG) Number 3114, Aeromedical Training of Flight Personnel (1986), each NATO flight student will receive academic instruction of spatial orientation and disorientation, which "should be reinforced by a practical demonstration of the effects of vestibular stimulation using a rotating chair or suitable disorientation device to provide each student with a personal experience of some of the common illusions." For refresher and continuation training of graduate aviators, the STANAG requires a review of mechanisms underlying disorientation and of management of disorientation in flight. A discussion of recent incidents is then conducted.

Although the above-described syllabus is necessary and important, the training can be less than stimulating. For decades, aviators have received the same didactic instruction over and over again. In fact, an examination of the syllabus and student handout, Spatial Disorientation and Sensory Illusions of Flight, produced and used by the United States Army School of Aviation Medicine to train Army pilots is typical of any NATO SD awareness training program.

This lack of creativity and innovation in regards to SD awareness training was confirmed during the author's attendance of two international scientific symposiums: 1) NATO Research and Technology/Human Factors and Medicine Workshop on Aeromedical Aspects of Aircrew Training, San Diego, California (October 1998); and 2) Recent Trends in Spatial Disorientation Research, San Antonio, Texas (November 2000). The majority of the presentations clearly espoused advances in aircraft equipment technology to mitigate the SD problem.

To their credit, some countries' air forces have tried to improve their aeromedical training and have procured small motion-based flight trainers, which produce both visual and vestibular illusions in pilots. A tremendous improvement over the Barany chair, these devices spin or lean to "confuse" the aviator's orientation senses and thus provides a disorienting experience from which the pilot must recover. An example of such a device is the Environmental Tectonics Corporation's Gyro IPT (Leland, 1998). No presentation, however, with the exception of the author's, indicated that any other country or agency was using the visual flight simulator of a pilot's primary aircraft as an SD awareness trainer.

Current computer technology has allowed some ingenious "repackaging" of the same aeromedical physiological training and turned it into an interactive experience. In a paper by Folio (2001), a Compact Disc-Read only Memory (CD-ROM) is described as a "method of consistently training across the whole spectrum of aviators." The CD-ROM, Spatial Disorientation Training Module for Aviators, includes imbedded videos that help convey important points and mnemonics that help pilots remember lists of information.

In another clever innovation, O'Donnell et al. (1999), of NTI, Incorporated, developed a low-cost, desktop flight simulator. Using a realistic aerodynamic flight model and embedding situational awareness measures, the program, termed the Situation Awareness Flight Training Evaluator (SAFTE), is used to assess an aviator's situational awareness, including spatial orientation, during the conduct of an entire simulated mission. Although a useful training and research tool, its applicability to the rotary wing environment is limited since the program is intended for use by high-performance fixed wing pilots.

Cheung (1998) describes and proposes an SD awareness training most similar to the USAARL-developed scenarios in a Canadian publication Recommendations to Enhance Spatial Disorientation Training for the Canadian Forces. In it, he writes:

> The Canadian Forces should examine the benefits of incorporation of SD training into present and future flight training simulators . . . Specific scenarios derived from accident sequences would be valuable for the student to obtain direct experience in preventing and overcoming SD in a realistic environment.

Therefore, SD awareness training, by using a visual flight simulator to replicate the conditions under which an actual SD accident occurred, appears to be unique to the USAARL-developed scenarios. The scenarios, as stated previously, were assessed as to their viability as a training method (Johnson et al., 1999). A review of the general findings will be useful.

In the study by Johnson et al., the scenarios were presented in a UH-60 visual flight simulator to 30 experienced aviators who completed subjective questionnaire evaluations after each scenario and finally, an overall evaluation. According to the report, the results showed "a high level of acceptance of this training tool by a group of experienced aviators with differing backgrounds." All answers to the questionnaire were positive and when asked at the end of the survey to add any further comments on the scenarios, the comments included:

> "This training should be added to all Army aviation training programs."
> "Excellent training."
> "Extremely realistic."
> ". . . should be implemented into the initial entry rotary-wing training . . . ."

And finally, Johnson et al. reported that the study demonstrated the potential benefit of utilizing helicopter flight simulators in the process of increasing pilot awareness of the hazards of SD. The scenarios are believed to be an effective training tool and were shown to be compelling and relevant.

Methods

Survey population

The survey population was a representative cross section of military personnel (active duty, reserve component and National Guard), DACs, and civilian contract simulator instructor/operators. The population included line pilots, instructor pilots, standardization instructor pilots, unit trainers, aviation platoon leaders, aviation staff officers, aviation commanders, and maintenance test pilots.

Data collection

The survey instrument was developed and written by the first author. A copy of the instrument is at the Appendix. The instrument was distributed and administered by the author, or in his absence, by his appointed representative. Every attempt was made to distribute the survey instrument to various military installations and facilities in order to gather a representative body of data. For example, survey instruments were distributed at conferences and meetings that were attended by representatives from large installations such as Ft. Bragg, North Carolina; Fort Campbell, Kentucky; Fort Benning, Georgia; Korea and Germany. In addition, completed survey instruments were collected during pilots' meetings at the Eastern Army National Guard Training Site, Harrisburg, Pennsylvania, and Fort Rucker, Alabama. Both locations are meccas for student aviators from all over the country and the world representing units from the National Guard and the active Army.

Participation in the survey was entirely voluntary. Additionally, participants were anonymous except that their general duties/positions and flight experience levels were requested to establish population demographics.

Data analysis

The data from the survey instrument were used to produce descriptive statistics and were further analyzed using EXCEL Version 97. These data were used to determine significant links between experience levels and SD experience, experience levels/duty positions and exposure to SD scenario training, and to ultimately determine the level of acceptance of the USAARL-developed SD awareness scenarios in the U.S. Army/National Guard aviation community.

Results

The results are reported and organized into five general subject areas as depicted in Table 1.

Table 1.
General subject areas.

Survey Questions	Subject Area
1 - 6	Sample demographic and flight experience profile.
7 - 8	Sample experience with actual SD.
9 - 12	Sample experience with SD awareness training.
12 - 19	Sample experience with and opinion of USAARL SD awareness training and its effects.
20	Sample opinion of recommended simulator SD awareness training in the U.S. Army/National Guard.

A total of 175 surveys were distributed with 134 being fully completed and returned, providing a response rate of 77%. Although not addressed by the questionnaire, the author noted that 43 respondents, or 32.1% of the sample, were National Guard personnel, while 91 (67.9%) represented the active duty force.

Demographics and experience profile

Figure 1 illustrates the survey sample's current positions or job distributions.

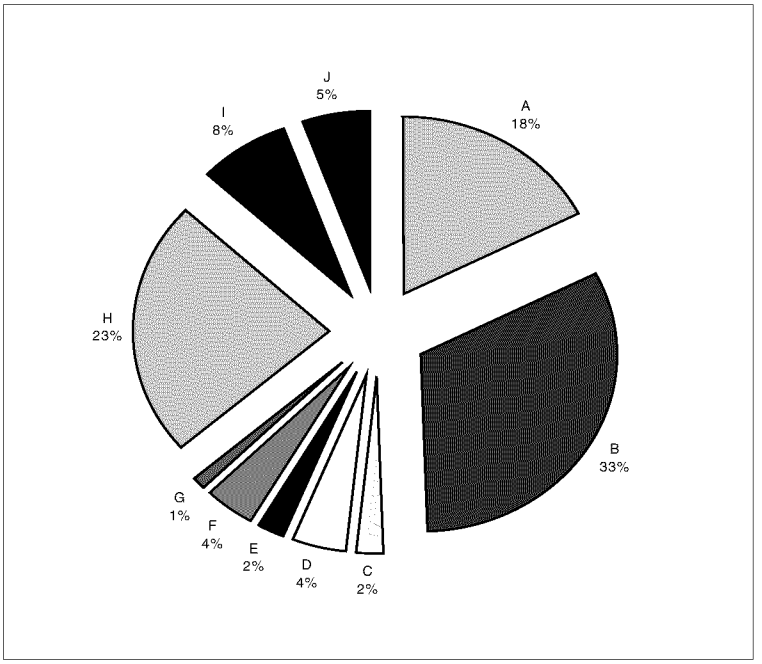

Figure 1. Positions/jobs distribution. A=line pilot, B=instructor pilot, C=aviation platoon leader, D=aviation company commander, E=aviation battalion commander or higher, F=Department of the Army civilian or civilian instructor operator, G=unit trainer, H=standardization instructor pilot, I=aviation staff officer, J=maintenance test pilot.

The results indicated that 91% had been pilots-in-command. Table 2 shows the distribution of Flight Activity Categories and Readiness Levels. (See Definition of Terms)

Table 2.
Distribution of FAC and RL.

	1	2	3	N/A	Totals
FAC	43 (32.1%)	75 (56.0%)	2 (1.5%)	14 (10.4%)	134 (100%)
RL	97 (72.4%)	7 (5.2%)	16 (11.9%)	14 (10.4%)	134 (100%)

The demography of total aircraft and simulated flight experience is presented in Figures 2 and 3, respectively. Total flight hours, aircraft and simulator, are usually reflective of an aviator's level of maturity, responsibility, and ability. Generally speaking, the greater the number of hours, the higher the pilot's capabilities. Note, also, that with more experience (flight hours) comes more exposure to flight conditions, making SD more likely to occur.

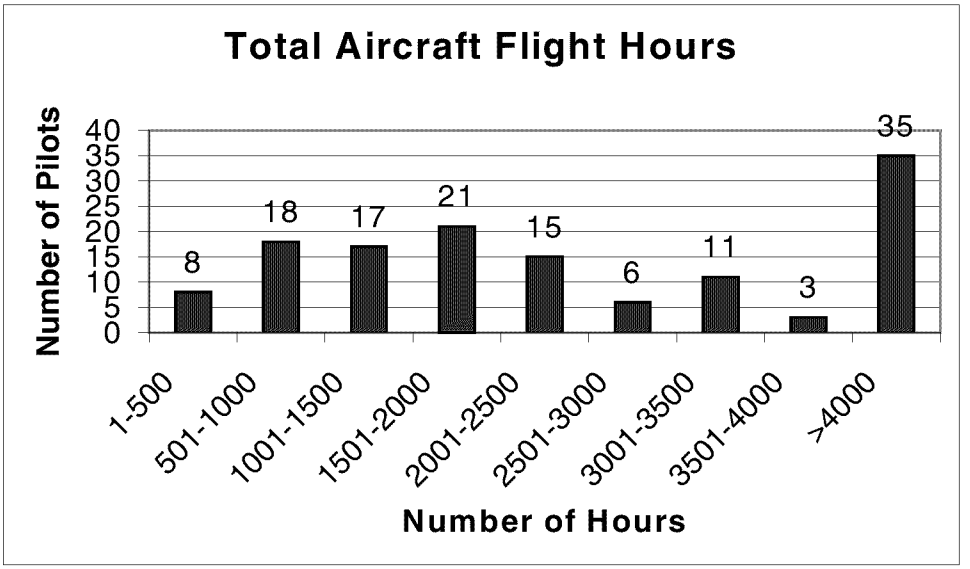

Figure 2. Total aircraft flight hours.

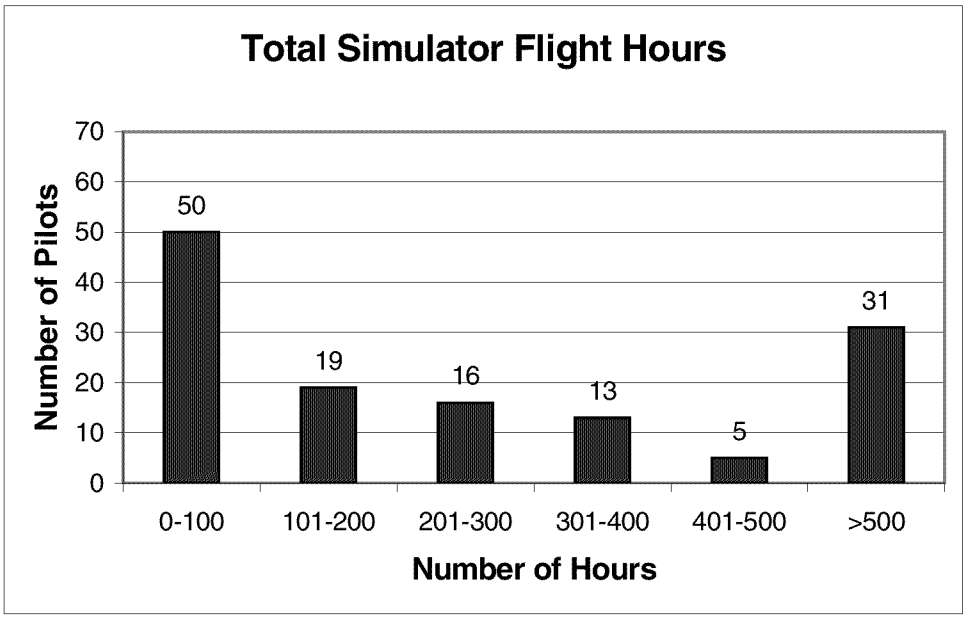

Figure 3. Total simulator flight hours.

Experience with actual SD

A review of the data revealed that 70.9% of the sample reported that they had had an SD experience in the actual aircraft. Those 95 respondents who answered positively to having had such an experience were asked to detail the experience(s) by providing the phase of flight, the number of times, and the flight mode during which it/they occurred. Table 3 provides the findings.

Table 3.
Reported SD experiences.

Phase of Flight	Of 95 Pilots, # Reporting	Of # Reporting Range of Times Reported	Number of Pilots Reporting in Flight Mode			
			Day	Night	NVG	IMC
Stationary Hover	24	1-20	5	10	16	3
Hovering Flight	21	1-20	4	8	14	2
Takeoff	14	1-25	3	3	3	11
Cruise Flight	60	1-20	10	14	9	48
Approach	23	1-20	3	7	7	14
Landing	22	1-20	8	5	18	2
Other (written in):						
External Load Pick-up	1	1	0	0	1	0
Aerobatic Flight	1	2	1	0	0	0
Operating in Snow	2	1-5	2	0	1	0
Traffic Pattern Turns	1	2	0	1	1	0
Climb from VMC into IMC	1	2	0	0	0	1

Figure 4 shows that as total flight time increases above 1000 hours, at least 71% of any given experience group has had at least one actual SD experience. Seventy-six percent of the entire sample reported having multiple SD events. An alarming finding is that 38% of the most inexperienced aviators (1-500 hours) had already experienced an SD event in their relatively short aviation careers.

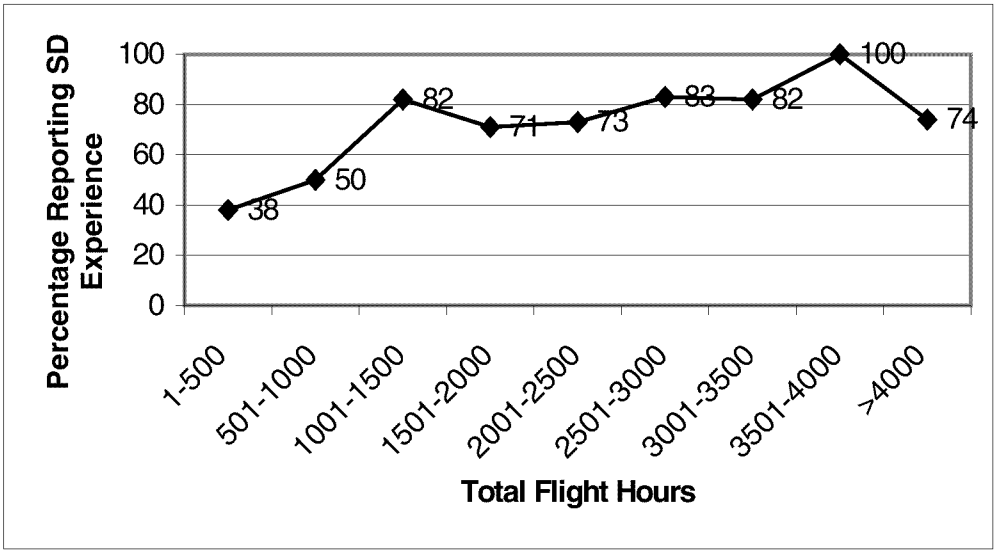

Figure 4. Percentage of reported SD experiences.

SD training experience

The next four questions of the survey instrument inquired as to the respondents' experience with SD awareness training in general.

The first question sought to establish the percentage of the sample that had ever heard of the USAARL SD Awareness Training Scenarios. Results showed that a slim majority (53%) had not heard of the scenarios. The data also indicated that although 75% of those having heard of the SD scenarios had also seen a demonstration, this number only reflected 35% of the entire sample. As for having received any manner of SD awareness/prevention training, 66, or 49%, responded yes. When all were asked if they had ever received or trained others using the USAARL Scenarios, only 30% answered yes. See Table 4 for additional results.

Table 4.
Aggregate SD training experience.

Survey Questions (abbreviated)	Yes	No
Ever heard of USAARL SD Awareness Training Scenarios?	63 (47%)	71 (53%)
Ever received a demonstration of USAARL SD Awareness Training Scenarios?	47 (35%)	87 (65%)
Ever received or trained others in any manner of SD training in a simulator?	66 (49%)	68 (51%)
Ever received or trained others using USAARL SD Awareness Training Scenarios?	40 (30%)	94 (70%)

Sub-sample comparisons

In order to more clearly examine and discern the field experience with SD training, the data collected were used to compare the Active Army with the National Guard. Table 5 illustrates this comparison.

Table 5.
Active duty/National Guard comparison.

Survey Questions (abbreviated)	Active Duty			National Guard		
	Yes	No	Don't Know	Yes	No	Don't Know
Ever heard of USAARL SD Awareness Training Scenarios?	38 (42%)	53 (58%)		25 (58%)	18 (42%)	
Ever received a demonstration of USAARL SD Awareness Training Scenarios?	26 (29%)	65 (71%)		21 (49%)	22 (51%)	
Ever received or trained others using USAARL SD Awareness Training Scenarios?	21 (23%)	70 (77%)		19 (44%)	24 (56%)	
Is using USAARL SD Awareness Training Scenarios mandatory in your unit?	1 (1%)	87 (96%)	3 (3%)	15 (35%)	27 (63%)	1 (2%)

In an attempt to determine the extent of the trainers' experience with SD training, the sub-sample data were further dissected and compared to produce Table 6. Note that the term "trainer" describes those reporting their current position/job title as instructor pilot, unit trainer, standardization instructor pilot, or DAC/Civilian Instructor/Operator. Note, also, that Table 6 displays only the percentages of "yes" responses of each sub-sample.

Table 6.
"Yes" response and percentages of sub-sample.

Military Component	Active Army		National Guard	
	Trainers	Others	Trainers	Others
Sample Size	55	36	24	19
Ever heard of USAARL SD Awareness Training Scenarios?	25 (45%)	13 (36%)	18 (75%)	7 (37%)
Ever received a demonstration of USAARL SD Awareness Training Scenarios?	16 (29%)	10 (28%)	15 (63%)	6 (32%)
Ever received or trained others using USAARL SD Awareness Training Scenarios?	13 (24%)	8 (22%)	14 (58%)	5 (26%)
Is using USAARL SD Awareness Training Scenarios mandatory in your unit?	0 (0%)	1 (3%)	10 (42%)	5 (26%)

Experience with USAARL SD awareness training

Of the 40 respondents who reportedly received or trained others using the USAARL SD Awareness Training Scenarios, 39 provided information regarding their experience with the training. (One individual did not answer Question 12 completely or Questions 13 through 19.)

Figure 4 indicates that 35, or 89.7%, of the sample regarded the training as necessary or higher, with a median rating of "Necessary and Interesting."

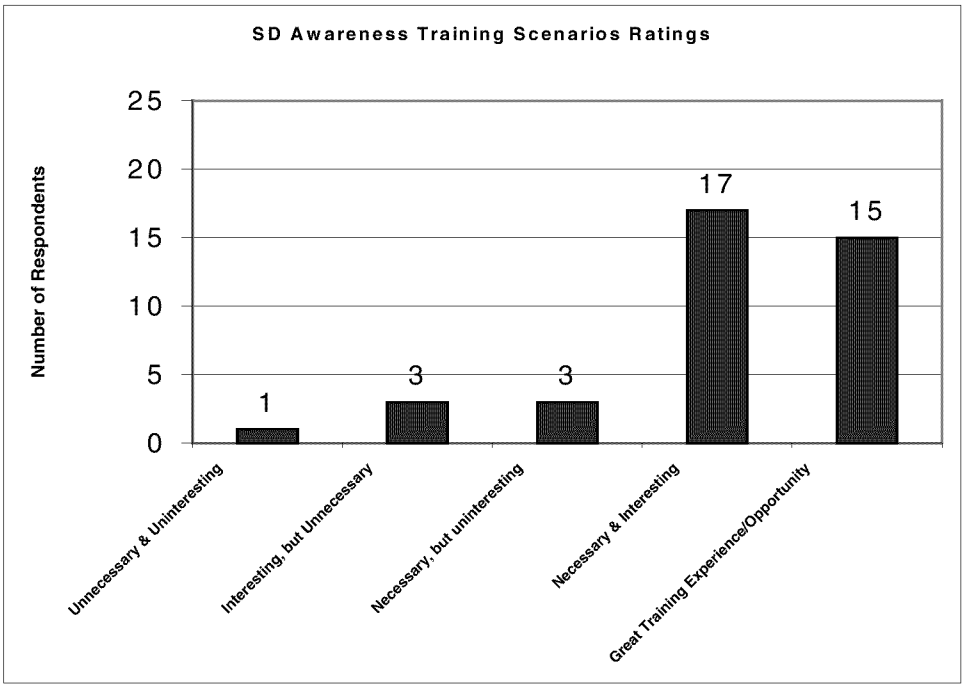

Figure 5. USAARL SD awareness training scenarios ratings.

USAARL SD awareness training scenario usage

Three questions were presented to determine the use and the use frequency of the USAARL SD Awareness Training Scenarios. When asked how many times they had received the training, over two-thirds (27) of the sub-sample indicated only once. As for using the scenarios to train others, 26 (67%) responded that they had used them (once to greater than 10 times) to train others. See Table 7 for the complete data distribution.

Table 7.
Frequency of use.

	Never	Once	Twice	3-5	6-10	>10
Number of times USAARL training was received.	N/A	27 (69%)	7 (18%)	3 (8%)	2 (5%)	0 (0%)
Number of times USAARL training was used to train others.	13 (33%)	7 (18%)	2 (5%)	4 (10%)	5 (13%)	8 (21%)

Mandatory use

In order to determine whether the training was performed on a voluntary basis or whether the unit's commander had required it, the sub-sample was asked if the use of the USAARL SD Awareness Training Scenarios was mandated by the unit's Aircrew Training Program. Forty-one percent said the training was mandatory, whereas 49% said the training was not mandated. Ten percent were not sure.

A look back at Table 5 (Active duty/National Guard comparison) shows a striking difference between the active force and the NG. Whereas 35% of the Guard reported that the training is mandatory in their units, only 1% of the active Army did.

Effectiveness

In addition to the above data, the respondents who reported experience with the USAARL scenarios were asked their opinions regarding the training's effectiveness and how, or if, it influenced or improved their flying awareness and communication skills (Table 8).

Table 8.
Assessment.

Opinion Survey Questions (abbreviated)	Yes	No	Not Sure	N/A
Did USAARL Scenarios training better prepare you to recognize factors which make SD more likely?	27 (69%)	5 (13%)	7 (18%)	0 (0%)
Did USAARL Scenarios training improve your ability to make better mission decisions?	26 (67%)	5 (13%)	8 (20%)	0 (0%)
Did USAARL Scenarios training improve your overall situational awareness?	28 (72%)	5 (13%)	6 (15%)	0 (0%)
Did USAARL Scenarios training improve your crew coordination skills?	28 (72%)	6 (15%)	5 (13%)	0 (0%)
Did USAARL Scenarios training actually prevent you from having an aircraft mishap/ accident?	3 (8%)	19 (49%)	17 (43%)	0 (0%)
Would all aviators benefit from being trained using the USAARL Scenarios?	35 (90%)	0 (0%)	4 (10%)	

Recommended SD Awareness Training

Finally, all respondents were asked if their annual simulator requirements should include some manner of SD awareness training and how often the training should occur. Ninety-seven of 134 individuals answered that simulator requirements should include SD awareness training, and the majority of those recommended that the training be conducted once annually, with an additional 48% recommending training frequency to be at least 2 times per year. See Figures 5 and 6.

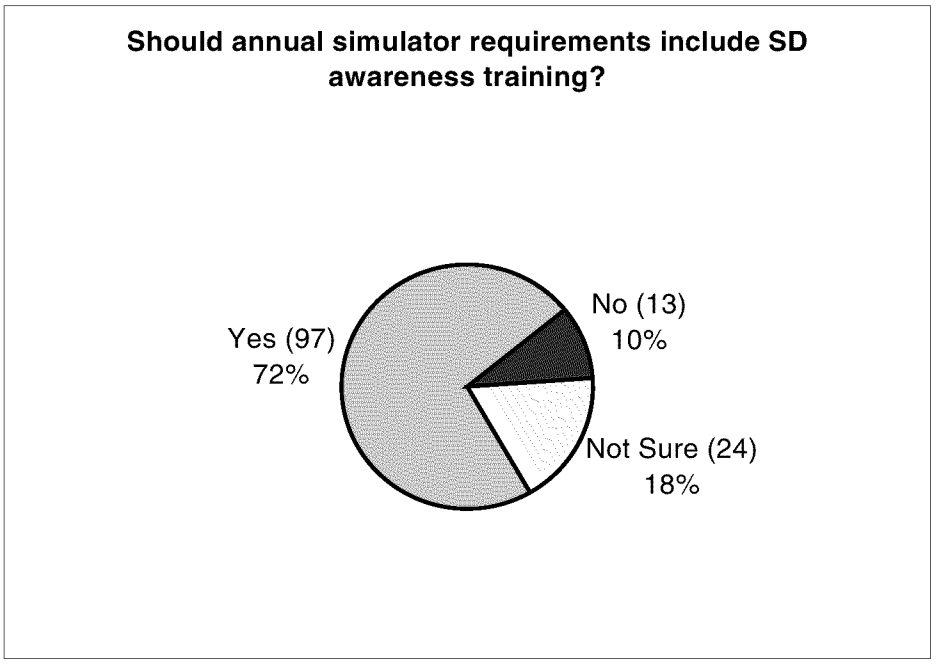

Figure 6. Simulator requirements and SD training.

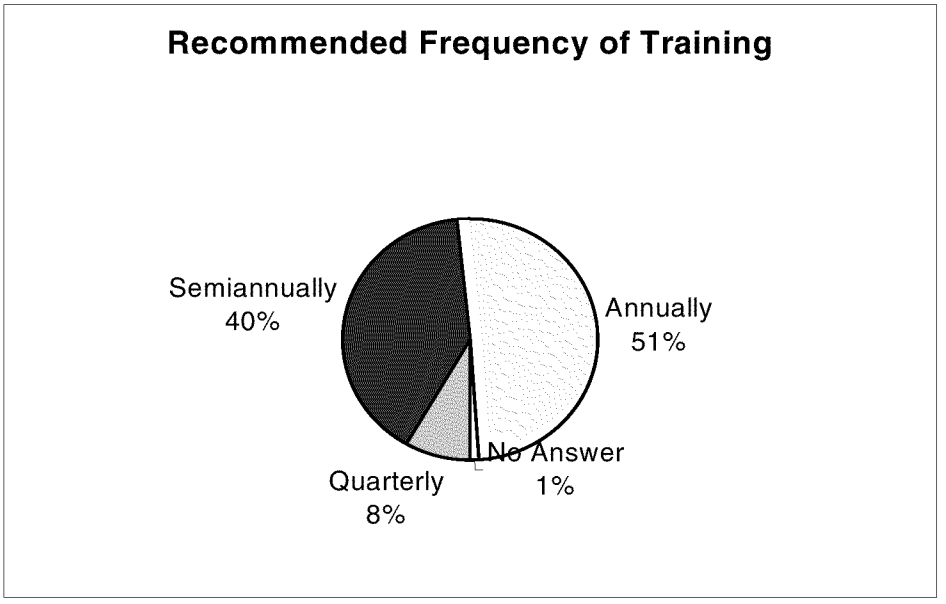

Figure 7. Recommended frequency of SD awareness training in a visual flight simulator.

Discussion

Demography

Although the respondents were anonymous and the surveys were distributed without regard to positions or jobs, a review of the data revealed that there was a large proportion of instructors and trainers who returned the surveys. In fact, even though the sample included representatives from all aviation positions and jobs, 61% were instructors and trainers. (This 61% of the sample was comprised of instructor pilots, standardization instructor pilots, civilian instructor/operators and unit trainers.) The fact that the surveys were distributed at two major Army aviation-training sites and that many of the surveys were distributed from various simulator facilities around the world where training is conducted may explain this concentration. Although this demography may not be statistically correct in representing the proportional population of the U.S. Army and National Guard, the large proportion of instructors and trainers returning the surveys was probably due to their interest and concern for training proposals and methods. An unintentional benefit of having a large instructor/trainer sample population is that the results are based on the comments and experience of those most qualified to assess a training program such as the USAARL SD Awareness Training Scenarios.

SD experience

Survey results indicate that a relationship exists between the amount of total flight time and those reporting SD experiences. As expected, as flight experience increases so do episodes of reported SD. The percentage of pilots reporting SD experiences increases sharply up to the 1500 hour experience level and appears to level off at approximately 80% for the remainder of their flying careers. These high percentages of reported SD events correlate with the high rates of SD accidents and mishaps referred to in the Introduction.

SD awareness training

Highly regarded, although not mandated, by USAAVNC leadership, the USAARL SD Awareness Training Scenarios are not receiving wide attention or use by the active force. The aggregate data (active Army and National Guard) retrieved from the questions relating to experiences with SD training (Table 4) demonstrated that the majority of the sample had not heard of or received training in the USAARL SD Awareness Training Scenarios. Keeping in mind that Army regulations do not require scenario training, the National Guard appears to be more committed to this training method. When the active duty Army is compared to the National Guard in Table 5, the Guard's enhanced commitment is clear. The survey indicates that 58% of the National Guard have heard of the training compared to only 42% of the active force. Whereas 23% of the active force have received the training, the Guard has trained an impressive 44%. In addition, only 1% of the active force reported that the scenarios were a mandatory part of their training, while 35% of the National Guard respondents said they were. After three years of promotion and availability, the USAAVNC leadership's strategy of marketing the training to aviation leaders for use on a voluntary basis appears to have been only minimally successful. Based on the data in Table 5, the Active Army has not integrated, and cannot be expected to integrate, the USAARL SD Awareness Training Scenarios into an active aviator's continuation training unless required to by regulation.

Arguably, the most important information collected from the survey may be that of the scenario training's effectiveness. According to the Instructor Pilot's Handbook (1991), in order for training to be successful, it must be purposeful, provide experience, and result in a change in behavior. Although a previous assessment, conducted in 1997 (USAARL Report No. 2000-06), proved that the USAARL scenarios, in a controlled study, were beneficial, effective, and well-received, their reception and appraisal by field units was unknown.

The results of this survey indicate that they were, indeed, deemed effective by the majority of those respondents with experience using the USAARL-developed scenarios. The following data reflect the majority's positive opinions of the training:

- Sixty-nine percent indicated that the training better prepared them to recognize those factors that made SD more likely.
- Sixty-seven percent indicated that the training improved their ability to make better mission decisions.
- Seventy-two percent indicated that the training improved their overall situational awareness and their air crew coordination skills.
- Three respondents felt that the training had actually prevented them from having an aircraft mishap/accident.
- Remarkably, 90% feel that all aviators would benefit from this training.

Finally, the collected information demonstrates that there is a desire by those in the field (72% of the sample) to have some manner of SD awareness training included in their annual simulator requirements. With the apparent support for such training, aviation leaders could implement a training program with minimal effort.

Conclusion

Spatial disorientation remains a formidable hazard to the U.S. Army aviation community. Based on the significant number of reported SD events, and if training is not improved, the Army aviator will have a real probability of becoming spatially disoriented in an actual aircraft during his/her aviation career. The preponderance of the sample population suggests that some form of simulator SD awareness training be developed. The research also revealed that despite USAAVNC promotion and demonstration to aviation leaders of the USAARL SD Awareness Training Scenarios, the majority of U.S. Army and National Guard aggregate have not been trained to recognize the factors which make SD more likely. Apparently, without specific guidance and a regulatory requirement, simulator SD awareness training will not be conducted on a voluntary basis.

Recommendations

Based on the conclusions achieved, this work recommends that aviation leaders mandate and regulate SD awareness training as part of an aviator's annual simulator requirement. An effective and proven method is by using the USAARL SD Awareness Training Scenarios as the basis of the program. The average USAARL SD Awareness Training Scenario takes approximately 10 minutes to perform and could be incorporated into an aviator's existing simulator training and annual hourly requirements. The training would be, in effect, transparent since no additional funds would be necessary.

Additional scenarios should be developed that target those phases of flight and flight modes identified in Table 3, such as cruise flight under instrument meteorological conditions, as being the most conducive to producing spatially disorienting effects.

As a final recommendation, aviators undergoing the U.S. Army's Instructor Pilots/Methods of Instruction (IPC/MOI) Courses should be qualified on the method of instruction and presentation of simulated SD awareness training scenarios. This would introduce this method of training to the instructor pilot, the one who would be in the best position to perpetuate and promulgate this type of training.

References

Benson, A.J. 1978. Spatial disorientation: general aspects. Aviation Medicine. London: Tri-Med Books.

Braithwaite, M. G., Groh, S., & Alvarez, E. 1997. Spatial Disorientation in U.S. Army Helicopter Accidents: An Update of the 1987-92 Survey to Include 1993-95. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 97-13.

Cheung, B. 1998. Recommendations to Enhance Spatial Disorientation Training for the Canadian Forces. DCIEM No. 98-R-32.

Durnford, S.J., Crowley, J.S., Rosado, N.R., Harper, J., & DeRoche, S. 1995. Spatial Disorientation: A Survey of U.S. Army Helicopter Accidents 1987 - 1992. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 95-25.

Estrada, A., Braithwaite, M. G., Gilreath, S.R., Johnson, P.A., & Manning, J.C. 1998. Spatial Disorientation Awareness Training Scenarios for U.S. Army Aviators in Visual Flight Simulators. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 98-17.

Folio, L. 2001. Standardized Spatial Disorientation Training on a Compact Disc. A paper presented to introduce CD-ROM program produced at the USAF School of Aerospace Medicine, Brooks Air Force Base, TX.

Headquarters, Department of the Army. 2000. Aeromedical Training for Flight Personnel. Washington, DC. Field Manual No 3-04.301.

Headquarters, Department of the Army. 1996. Aircrew Training Program Commander's Guide to Individual and Crew Standardization. Washington, DC. Training Circular 1-210.

Headquarters, Department of the Army. 1994. Safety - Accident Reporting and Records. Washington, DC. AR 385-40.

Hencshel, D.S. 2000. Army Hypobaric Chamber Refresher Frequency Study. Graduate Research Project presented to Embry-Riddle Aeronautical University, Fort Rucker, AL.

Johnson, P.A., Estrada, A., Braithwaite, M. G., & Manning, J.C. 1999. Assessment of Simulated Spatial Disorientation Scenarios in Training U.S. Army Aviators (Reprint). Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report No. 2000-06.

Leland, R.A. 1998. Spatial Orientation Training for Aircraft Operators - A Pilot's Workbook for Spatial Disorientation Training. Environmental Tectonics Corporation, Southampton, PA.

North Atlantic Treaty Organization (NATO), Military Agency for Standardization (MAS). Aeromedical Training Of Flight Personnel. Neuilly-sur-Seine, France. Standardization Agreement (STANAG) No. 3114 (Edition 6).

O'Donnell, R.D., Moise, S., Smith, R., Cardenas, R., Eddy, D., O'Donnell, R.L. 1999. Development of the Situation Awareness Flight Training and Simulation Evaluation (SAFTE) System: II. Final Development, Initial Test, and Documentation of the System. NTI, Incorporated, Dayton, OH.

United States Army Aviation Center. 1991. Instructor Pilot's Handbook. Fort Rucker, AL.

United States Army School of Aviation Medicine. 1999. Student Handout Title: Spatial Disorientation And Sensory Illusions Of Flight. Fort Rucker, AL. File Number: 2/5/9/9e/Uea/Uec/Uee-4505-3.

Appendix

Survey instrument

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama

SPATIAL DISORIENTATION AWARENESS TRAINING SCENARIOS SURVEY

Please circle the responses that most accurately answer the following questions.

1. What term best describes your current position or job title.

Line Pilot — Unit Trainer

Instructor Pilot — Standardization Instructor Pilot

Aviation Platoon Leader — Aviation Staff Officer (any level)

Aviation Company Commander — Maintenance Test Pilot

Aviation Battalion Commander or above

Civilian (DAC or Contractor) Simulator Instructor/Operator (IO)

2. Are you currently or have you ever been a pilot-in-command (include limited PC duties)?

Y N NA

3. What is your current Flight Activity Category (FAC) designation?

1 2 3 NA

4. What is your current Readiness Level (RL)?

1 2 3 NA

5. How many total flight hours have you logged (exclude simulator)?

1-500 501-1000 1001-1500 1501-2000 2001-2500 2501-3000

3001-3500 3501-4000 4001 or greater

6. How many total visual flight simulator hours have you logged (exclude UH-1 simulator)?

0-100 101-200 201-300 301-400 401-500 501 or greater

7. To the best of your knowledge, have you ever experienced SD in the actual aircraft?

Y (Go to question 8) N (Skip question 8, go to question 9)

8. Yes, I have experienced SD under the following conditions:

Phase of Flight	Number of Times (If none, leave blank.)	Flight Mode (Circle all that apply)
At a stationary hover.		Day Night (unaided) NVG IMC
During hovering flight.		Day Night (unaided) NVG IMC
During takeoff.		Day Night (unaided) NVG IMC
During cruise flight.		Day Night (unaided) NVG IMC
During approach.		Day Night (unaided) NVG IMC
During landing.		Day Night (unaided) NVG IMC
Other: (Identify)		Day Night (unaided) NVG IMC

9. Previous to the pre-survey briefing, had you ever <u>heard</u> of the USAARL Spatial Disorientation Awareness Training Scenarios?

Y N

10. Have you ever received a demonstration of the USAARL Spatial Disorientation Awareness Training Scenarios?

Y N

11. Have you ever received or trained others in any manner of spatial disorientation awareness/prevention training in a visual flight simulator?

Y N

12. Have you ever received or trained others using the USAARL Spatial Disorientation Awareness Training Scenarios?

Y N (Go to question 20)

If yes, how would you rate the USAARL SD Awareness Training Scenarios?

1 = Unnecessary and uninteresting.

2 = Interesting, but unnecessary.

3 = Necessary, but uninteresting.

4 = Necessary and interesting.

5 = Great training experience/opportunity.

If yes, approximately how many times have you received the training?

Once Twice 3 to 5 5 to 10 Greater than 10

If yes, approximately how many times have you used the scenarios to train others?

Never Once Twice 3 to 5 5 to 10 Greater than 10

13. Is training using the USAARL SD Awareness Training Scenarios mandatory in your unit's Aircrew Training Program?

Y N Not Sure N/A (Civilian IO only)

14. In your opinion, did the USAARL SD Awareness Training Scenarios better prepare you to recognize those factors which make spatial disorientation more likely?

Y N Not Sure N/A (Civilian IO only)

15. In your opinion, did the USAARL SD Awareness Training Scenarios improve your ability to make better mission decisions during actual aircraft flight operations?

Y N Not Sure N/A (Civilian IO only)

16. In your opinion, did the USAARL SD Awareness Training Scenarios improve your overall situational awareness?

Y N Not Sure N/A (Civilian IO only)

17. In your opinion, did the USAARL SD Awareness Training Scenarios improve your crew coordination skills?

Y N Not Sure N/A (Civilian IO only)

18. In your opinion, do you believe that training received using the USAARL SD Awareness Training Scenarios actually prevented <u>you</u> from having an aircraft mishap/accident?

Y N Not Sure N/A (Civilian IO only)

19. In your opinion, do you believe that all aviators would benefit from being trained using the USAARL SD Awareness Training Scenarios and should receive the training?

Y N Not Sure

20. Do you believe that an aviator's annual simulator requirements should include some manner of SD Awareness Training?

Y N Not Sure

If yes, how often would you recommend SD Awareness Training in the simulator?

Once quarterly Once semiannually Once annually

THANK YOU FOR YOUR PARTICIPATION