



**Spatial Disorientation Awareness Training
Scenarios for U.S. Army Aviators in
Visual Flight Simulators**

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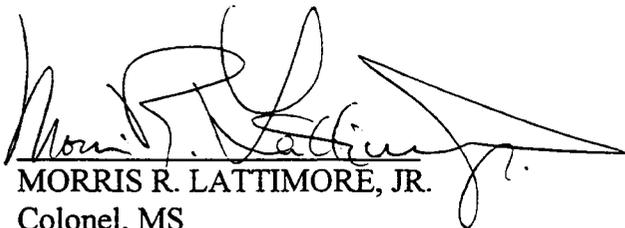
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19. ABSTRACT (Continue on reverse if necessary and identify by block number) Spatial disorientation (SD) remains an important source of attrition in military flying. SD was considered to be a significant factor in 291 (30 percent) of Class A-C helicopter accidents in the U.S. Army during an 8-year period between 1987 and 1995. The monetary cost of SD is high and the fatality rate is between one and one half to two times that of non-disorientation accidents. One method of reducing the impact of SD is through enhanced awareness and training of aviators. 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. Actual SD accident summaries from the U.S. Army Safety Center (USASC) were reviewed and those accidents which could reasonably be replicated in a visual simulator were selected. The resulting visual simulator scenarios are used to train aviators to recognize, avoid and overcome SD. In addition, the scenarios provide training to assist aviators in overcoming SD once encountered. Other, yet equal, benefits from this method of training are the reinforcement of aircrew coordination elements and the development of decision-making, risk assessment, and judgement skills.												
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Introduction

This report describes training that has been developed to combat one of the most prevalent contributing factors to aviation mishaps, spatial disorientation.

Spatial disorientation (SD) remains an important source of attrition in military flying. FM 1-301, Aeromedical Training for Flight Personnel, states that “SD contributes more to aircraft accidents than any other physiological problem in flight”. Regardless of their flight time or experience, all aircrew members are subject to SD. The human body is structured to perceive changes in movement on land in relation to the center of the earth. In an aircraft, the sensory systems may give the brain erroneous orientation information, from a combination of many factors within the cockpit environment: loss of situational awareness, task overload, poor aircrew coordination, marginal weather and visibility, and so on. The culmination of this all too often results in more data for the accident reports.

According to U.S. Army Safety Center (USASC), SD was considered to be a significant factor in 291 (30 percent) of Class A-C helicopter accidents in the U.S. Army during an 8-year period between 1987 and 1995. One hundred and ten 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 non-disorientation accidents.

One of the means of reducing the impact of SD is through enhanced awareness and training of aviators. While aviators may have had some experience of recovery 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 in support of a U.S. Army Aeromedical Research Laboratory (USAARL) research protocol for the assessment of simulated spatial disorientation scenarios in training U.S. Army aviators. A study was conducted to assess the feasibility of utilizing visual simulator scenarios to train aviators to recognize, avoid and overcome SD. Actual SD accident summaries from the USASC were reviewed and those accidents which could reasonably be replicated in a visual simulator were selected. The research data collected indicated a very favorable response to this method of training. The result was that aviators receiving 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 elements and the development of decision-making, risk assessment, and judgement skills.

Based on these findings, a series of scenarios were developed for training U.S. Army aviators in the recognition and avoidance of SD, stressing situational awareness and proper aircrew coordination techniques. This paper presents the details of this training method.



Methods

The following scenarios have been developed to re-create the conditions under which SD accidents have occurred. Due to the restrictions and limitations of visual flight simulators, some scenarios have been modified in order to enhance training while maintaining the core lesson.

Each scenario script is divided into three sections.

1. The first section, Simulator Initial Conditions, lists those steps required of the simulator instructor/operator (IO) in order to replicate the environmental conditions under which the actual SD accident occurred.
2. The next section is the Scenario Development. This section provides a premission briefing; however, it is limited. (It is assumed that all premission planning met the crew's satisfaction and a crew mission briefing was accomplished and acknowledged.) The briefing is followed by notes, addressed to the trainer and the IO, which outline the manner of presentation and events which will lead to the SD experience.
3. The final section contains the Debriefing. This section contains the summary of the actual accident upon which the scenario was developed. The summary is followed by training guidance for the trainer and a series of questions which will reinforce the lessons of each SD experience.

The trainer and IO are encouraged to embellish the scenarios in order to enhance the urgency and realism of the situations as long as the core lesson remains the same. All air traffic control calls and responses will be performed as if actually operating in the class of airspace specified in the scenario. Additionally, the trainer or IO should interject comments or responses that would normally be expected from a crew chief or flight engineer performing crew duties on board the actual aircraft. Also, all aircraft checks will be performed by the checklist when appropriate.

Although the scenarios are performed to provide a greater awareness of spatial disorientation, the opportunity to impart other lessons is available. The trainer should consider the following areas:

1. Maintenance of Visual Flight Rules (VFR) or Instrument Flight Rules (IFR)
2. The difference between VFR and Visual Meteorological Conditions (VMC); the difference between IFR and Instrument Meteorological Conditions (IMC)
3. Aircrew coordination
4. Decision making/problem solving
5. Judgement
6. Situational awareness

All coordinates presented in the scenarios apply to the AH-64, CH-47, and UH-60 flight simulators since the terrain data bases are the same.



SECTION I: DAY/SINGLE SHIP



SPATIAL DISORIENTATION SCENARIO #1

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets the visibility to 0.3 mile.
3. Requests snow conditions. (Some simulators are not capable of creating snow conditions. In such cases, dust conditions may be substituted.)

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PC and I (the trainer) will play the role of the PI. Our mission is to perform hover training in snow (dust) conditions just south of the runway in South Sod. We are located at an airfield in Class D airspace. The weather is reported to be 2000 overcast with ½ sm visibility. The winds are calm. Due to the visibility and Class D airspace, a special VFR clearance will be required to operate in the South Sod. After receiving clearance, I will takeoff to a hover and hover taxi the aircraft, at 50 feet above ground level (AGL), down the length of Runway 20. At the end of the runway, I will turn to heading 190 and taxi approximately 400 meters to the field located at 21SWK1610063700." Perform before takeoff check and call for clearance.

TRAINER NOTE: The trainer establishes and maintains the aircraft in a 50 foot hover above the blowing snow. The trainer will mention seeing another aircraft in the distance and then direct the student to change the UHF radio frequency to Ground Control. While the student's attention is focused inside, the trainer begins an undetectable descent and drift to the rear. As the aircraft descends below 15 feet or when the student becomes aware of the dangerous situation, the trainer states, "I have vertigo, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The aircraft was at a 25 foot hover over snow-covered terrain when the PI, who was on the controls, inadvertently allowed it to descend rearward and contact the ground. The PI did not detect the drift and descent because his attention was focused on another aircraft moving to the front. The environmental conditions (fog/snow) resulted in a lack of visual cues. The PC, whose attention was focused inside, tried to take control of the aircraft, but over-controlled it by applying excessive collective. He did not have adequate time to acquire visual cues, reference points, or aircraft instrument indications. The result was that the aircraft ascended to approximately 50 feet, began a spinning descent, contacted the ground and was destroyed.



2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of visual cues. (Blowing snow)
- (2) Perception of linear motion below threshold. (Drift too gradual to perceive)
- (3) Aircrew coordination failure. (Improperly focused attention)
- (4) Reaction was excessive. (Excessive control inputs)
- (5) Poor awareness of the risk of spatial disorientation in those flight conditions.

c. "How could this accident be prevented?"

- (1) Use proper aircrew coordination procedures.
- (2) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations.

d. "How could this situation be overcome once you're in it?"

By performing a go around.

3. If necessary, the trainer will demonstrate the preventive action by:

- a. Performing proper aircrew coordination.
- b. Performing proper snow hovering techniques.

4. If necessary, the trainer will demonstrate the corrective action by performing a go around per the ATM.



SPATIAL DISORIENTATION SCENARIO #2

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets visibility to 0.5 mile.
3. Requests snow conditions. (Some simulators are not capable of creating snow conditions. In such cases, dust conditions may be substituted.)

Scenario Development:

TRAINER READS TO STUDENT: Permission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to perform snow (dust) landing training at an LZ located at 21SWK2043864147. We will be taking off from this airstrip which is located in Class G airspace. The weather is 2000 overcast with ½ sm visibility. Winds are calm. After takeoff, you'll fly, at terrain flight altitudes and 120 knots, to the LZ located on the side of the hill at the above coordinates where we'll practice snow landings. I'll take the controls at about 2 kilometers out and demonstrate the first approach. I've done several approaches to other fields earlier today with a different PI. All went well." Perform a before takeoff check.

TRAINER NOTE: The trainer establishes the aircraft on final approach on a heading of 090 to the sloping field. The trainer intercepts an approach angle and proceeds to land straight to the ground, with consideration for the slope. As the aircraft descends into the blowing snow, the trainer acts as if he is uncomfortable with the slope and begins a lateral drift to the right. The trainer then acts as if he is disoriented and states, "I've lost all visual references, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The unit IP was conducting snow landing training to a sloping, snow-covered field. The IP had performed several approaches that day to other snow-covered fields. During an approach, the IP decided to terminate straight to the ground, a technique that was not suitable for the landing site selected. After touching down, he felt uncomfortable with the slope and attempted to abort the landing while engulfed in a rotor-induced blowing snowcloud (whiteout). As he tried to fly out of the whiteout condition, he lost all outside references and drifted into a treeline. The aircraft incurred major damage.

2. Ask the student:



- a. "Why did this happen?" (Solicit feedback from student.)
 - b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)
 - (1) Procedures not per published guidance. (TC 1-212, VMC Approach, does not recommend terminating to surfaces when new or powder snow or fine dust is present.)
 - (2) Lack of visual cues. (Snow/dust)
 - (3) Perception of linear motion below threshold. (Drift too slow to perceive)
 - (4) Overconfidence. (Earlier experience making approaches)
 - (5) Complacency. (Overconfidence leads to complacency)
 - c. "How could this accident be prevented?"
 - (1) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations.
 - (2) Maintain situational awareness.
 - d. "How could this situation be overcome once you're in it?"

By performing a go around.
3. If necessary, the trainer will demonstrate the preventive action by:
- a. Performing proper landing zone selection.
 - b. Performing proper snow landing techniques.
 - c. Performing proper slope landing techniques.
4. If necessary, the trainer will demonstrate the corrective action by performing a go around.



SPATIAL DISORIENTATION SCENARIO #3

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets initial visibility to 3 miles.
3. Selects FARP #46.
4. Selects lighting level 5 for CULTURAL AIRBASE, RUNWAY, and APPROACH. Also, select VASI/VAPI, BEACON, and STROBE.

Scenario Development:

TRAINER READS TO STUDENT: Pre-mission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport passengers (VIP's) from the airfield to a FARP located at 21SWK0386064830 so that they can watch a demonstration of new FARP equipment. The FARP is equipped with a "Y" which is oriented 050 degrees. This mission has required several sorties with two remaining. You (the student) are replacing the PI that flew the first two sorties with me earlier in the day. I am very familiar with the route: The current weather is 2000 overcast with 3 sm visibility. Winds are calm. After takeoff from the airfield, you will fly bearing 290, at terrain flight altitude (200 feet and below), directly to FARP #46, located at 21SWK0386064830. Terrain flight altitudes will be maintained throughout the mission, even while crossing mountains. Upon arrival at the FARP, you will execute a VMC approach to the "Y", drop off passengers, and return to the airfield to pick up the remaining passengers." Perform a before takeoff check.

TRAINER NOTE: The trainer or IO will act as the Air Traffic Controller and require the crew to adhere to ATC procedures at an airfield in Class D airspace. The first sortie is uneventful.

IO NOTE: Once on the ground at the FARP, the IO reduces the visibility to 1.0 miles. This will require a special VFR clearance for the landing and the subsequent takeoff from the airfield. Unless requested by the student, no weather update will be provided at the airfield. If requested, the current weather of 2000/1 will be given.

TRAINER NOTE: The trainer will request clearance to land at the base of the tower for passenger pickup. After simulating passenger pickup and receiving a special VFR clearance for takeoff, the trainer will take the controls, will fly the same route toward the FARP.

IO NOTE: At 5 kilometers prior to crossing the north/south mountain range located at 21SWK0800065000, the IO will reduce the visibility to 0.2 miles. At 1 kilometer prior to crossing the north/south mountain range, the IO will reduce the visibility to 0.0 miles.

TRAINER NOTE: Upon losing visibility, the trainer will not perform IIMC procedures and thus, fail to establish a climb. The trainer will state, "I am disoriented, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.



Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While on a VFR service mission (single pilot, OH-58), the PC entered IIMC because he elected to depart, under a special VFR clearance, without updating his enroute weather. It is suspected that he decided not to update his enroute weather because he was very familiar with the route, having flown it a number of times. This may have caused complacency and overconfidence. After entering IIMC, the PC failed to perform IIMC procedures IAW the local SOP (and the ATM) by not adjusting power and airspeed, and establishing a climb. It is suspected that excitement, apprehension and concern upon entering IIMC may have affected the pilot's thought process and he may have avoided climbing in hopes of reentering visual meteorological conditions. He may not have totally accepted the fact that he was in an actual IMC situation. His failure to establish a climb caused the aircraft to crash into a wooded mountainside destroying the aircraft and fatally injuring the occupants.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

(1) Procedures not per published guidance. (AR 95-1 requires maintenance of VFR. Once out of Class D airspace, there was no way to maintain VFR (day) with less than ½ sm visibility.)

(2) Lack of visual cues. (Fog)

(3) Overconfidence.

(4) Complacency.

(5) Poor mission planning. (AR 95-1 requires weather to be updated.)

(6) Under-reaction. (Didn't immediately perform IIMC procedures)

c. "How could this accident be prevented?"

(1) Follow published requirements and directives.

(2) Perform tasks and maneuvers per the ATM.

(3) Maintain situational awareness.

d. "How could this situation be overcome once you're in it?"

By performing inadvertent IMC procedures per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by:



- (a) Updating weather.
- (b) Landing or turning back when VFR cannot be maintained.

4. If necessary, the trainer will demonstrate the corrective action by performing IIMC procedures per the ATM.



SPATIAL DISORIENTATION SCENARIO #4

Simulator Initial Conditions:

The IO selects IC#5 (TACTICAL - HARRIS FIELD).

Scenario Development:

TRAINER READS TO STUDENT: Pre-Flight Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to perform NOE terrain flight training; including confined area operations. We are departing from an airstrip located in Class G airspace. The weather is 2000 overcast with 3 3/4 sm visibility. The winds are calm. After takeoff from the airstrip, we'll fly, at NOE altitudes (25 feet and below), directly to an LZ located at 21SWK2043864147.

TRAINER NOTE: Upon arrival, the trainer will make an approach and establish a 40 foot stationary hover on heading 060 degrees. The student is then directed to change a radio frequency and set the parking brakes. While the student's attention is focused inside, the trainer will allow the aircraft to drift down and to the right encountering brownout conditions. Just prior to ground contact, the trainer will apply right cyclic and lower the collective. The trainer states, "Help, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The aircraft was at a stationary IGE hover over sloping terrain during an NOE training mission. The PC, who was at the controls, improperly divided his attention and allowed the aircraft to drift to the right into the sloping terrain. The PC, reacting to the ground contact, over-controlled the aircraft by adding excessive left cyclic and reducing the collective abruptly causing the rotor blades to contact the ground. The aircraft landed hard causing further damage which resulted in a destroyed aircraft.

2. Ask the student:

- a. "Why did this happen?" (Solicit feedback from student.)
- b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)



- (1) Aircrew coordination failure. (Improperly divided attention)
- (2) Perception of linear motion below threshold. (Drift too gradual to detect)
- (3) Improper reaction. (Overcontrolled aircraft)
- (4) Overall poor situational awareness.

c. "How could this accident be prevented?"

- (1) Perform proper aircrew coordination.
- (2) Maintain situational awareness.
- (3) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations.
- (4) Perform a more accurate risk assessment.

d. "How could this situation be overcome once you're in it?"

After ground contact, by first increasing collective to gain ground and obstacle clearance prior to applying cyclic (lateral) inputs. (Performing a go around)

3. If necessary, the trainer will demonstrate the preventive action by:

- a. Performing proper dust hovering techniques.
- b. Performing proper aircrew coordination.

4. If necessary, the trainer will demonstrate the corrective action by performing a go around per the ATM.



SPATIAL DISORIENTATION SCENARIO #5

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Sets visibility to 1.0 mile.

Scenario Development:

TRAINER READS TO STUDENT: Pre-mission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to conduct a local area orientation and overwater training. They like me to do these orientation flights above 400 feet, but I don't think it's necessary, especially over the water. We are departing from an LZ located in Class G airspace. The weather is 1000 overcast with 1 sm visibility. Winds are calm. After takeoff from the LZ, I'll fly at 90 knots on a heading of 180 degrees. I'll show you an island which is located about 10 kilometers south of here where we do a lot of tactical training." Perform a before takeoff check.

TRAINER NOTE: Once over the water, the trainer will descend to an altitude below 25 feet and state, "I like guys in our platoon to fly low and fast. The troops love it." The IP then directs the PI to change a radio frequency, thus directing his attention inside the aircraft. While the PI's attention is focused inside, the trainer will initiate a slow descent and then "come inside" to assist with the frequency change. He will then look out and state, "Oh, \$#*+!, I've lost it, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While on a training mission, the aircraft was flown over the surface of a large, deep, fresh water lake at very low altitudes (below 10 feet) and at a high airspeed (90-100 knots). This flight profile left little room for error. (The crew's mission briefing had imposed a 400 foot minimum enroute altitude flight restriction.) During the overwater segment, the P*, who was also the PC, was directing the PI on his requirements for the remainder of the flight. This caused the P* to focus his attention inside the aircraft. The P* failed to maintain a safe altitude above the surface of the water and as a result, the helicopter struck the water with explosive force and sank immediately.

2. Ask the student:
 - a. "Why did this happen?" (Solicit feedback from student.)



b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Total disregard for regulations and directives. (Disregarded mission restrictions)
- (2) Aircrew coordination failure. (P* must remain focused outside)
- (3) Lack of or poor visual cues. (Overwater)
- (4) Probable visual illusion. (Height perception illusion)
- (5) Overconfidence.
- (6) Poor awareness of the risk of spatial disorientation in those flight conditions.
- (7) Self-imposed task overload. (Too low, too fast)

c. "How could this accident be prevented?"

- (1) Follow regulations and directives.
- (2) Perform proper aircrew coordination.
- (3) Be familiar with potential visual illusions.

d. "How could this situation be overcome once you're in it?"

By performing a go around per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by performing proper aircrew coordination.

4. If necessary, the trainer will demonstrate the corrective action by performing a go around per the ATM.



SPATIAL DISORIENTATION SCENARIO #6

Simulator Initial Conditions:

The IO:

1. Selects IC#7 (TACTICAL OP NO. 2).
2. Reduces the fuel level to approximately 250 pounds in each fuel tank.
3. Selects DUSK as the scene illumination.
4. If necessary, selects SOUND LEVEL 1.

Scenario Development:

TRAINER READS TO STUDENT: Permission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. It is dusk. We have just landed at the "Y" of a FARP and I will ground taxi to the NW corner of the field for refuel." Perform an after landing check.

TRAINER NOTE: The trainer will taxi the aircraft on heading 320 degrees until a parked AH-64 is visible. The trainer will explain that the AH-64 is parked at a refuel point and that the desired point is to the right of it. (There is no actual fuel point at this location in the database.) Upon arriving very near the AH-64, the trainer will initiate a right pedal turn to heading 090 degrees. During the turn, the trainer will direct the student to take the controls and continue the pedal turn to simulate exposure of the aircraft refueling port to the refueling point. The trainer will ensure that the turn is performed near enough to the AH-64 to simulate contact. As the aircraft's tail swings to the left, the trainer will state, "I think we hit that aircraft."

IO NOTE: Upon hearing the trainer's statement, the IO will immediately select the "MAIN ROTOR BLADE DAMPER FAIL" malfunction listed on the ROTOR SYSTEM Malfunction Page in order to induce a main rotor blade vibration. Should there be actual contact and the simulator "freezes", the IO will select "CRASH OVERRIDE," allow the student to taxi clear of the AH-64, and then deselect "CRASH OVERRIDE."

TRAINER NOTE: After the simulated contact, the trainer will direct the student to taxi a safe distance away and shut down the aircraft (perform emergency engine shutdowns). (AC power will be lost due to the loss of rotor RPM.) The training flight concludes when the engines are shutdown.

Debriefing:

1. Tell the student, "That was spatial disorientation. **The point is that spatial disorientation occurs on the ground also.** The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While ground taxiing the aircraft to a refuel pit at dusk, the crew noticed another aircraft shutdown and parked at the pit. The crew decided to attempt to get as close to the pit as safety would allow in order to refuel. Upon arrival at the pit, the PC



turned the tail to the left to expose the aircraft refueling port to the pit. After the turn, the crew felt a vibration and noticed a tilt in the rotor. Realizing they had hit the parked aircraft, the PC moved a safe distance and shutdown the aircraft. After shutdown, the crew inspected both aircraft and confirmed the collision.

2. Ask the student:

- a. "Why did this happen?" (Solicit feedback from student.)
- b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)
 - (1) Dusk conditions. (Mesopic vision)
 - (2) Misjudged clearance.
 - (3) Aircrew coordination failure. (Should use crew chief or ground guide)
- c. "How could this accident be prevented?"
 - (1) Perform proper aircrew coordination.
 - (2) By requiring a ground guide during ground operations in close proximity to other aircraft and structures.
- d. "How could this situation be overcome once you're in it?"

Although the situation cannot be overcome, an emergency engine shutdown should be accomplished.

3. If necessary, the trainer will demonstrate the preventive action by performing proper aircrew coordination.
4. If necessary, the trainer will demonstrate the corrective action by performing an emergency engine shutdown.



SECTION II: DAY/MULTIAIRCRAFT



SPATIAL DISORIENTATION SCENARIO #7

Simulator Initial Conditions:

NOTE: This scenario requires the pre-recording of a leadship by the IP or IO. The leadship will originate at Harris Field (IC#5) and be flown at contour flight altitudes (25 to 80 feet) at 100 knots to and landed at the brown field located at 21SWK2022057800. Prior to initiating the recording, taxi the aircraft forward approximately 100 feet. This will place the leadship in front of the simulator as if it were Chalk 1 during the playback and accident re-creation. After landing, continue the recording for approximately 30 seconds so that the leadship doesn't just disappear.

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. "PLAYBACK" of the appropriate leadship (1,2, or 3).
3. Ensures that "BLOWING SAND AND DUST" is activated.

Scenario Development:

TRAINER READS TO STUDENT: Pre-mission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to insert infantry soldiers into an unreconned LZ located at 21SWK2022057800. We are Chalk 2 in a flight of four, although only Chalk 1 will be visible. The weather is 2000 overcast with 3-3/4 sm visibility. Winds are calm. The ground and air commanders are very eager to get this mission accomplished and have applied command pressure. I am a very inexperienced PC, but feel confident that I can get the job done. After takeoff from the airfield, you will follow the leadship in a trail formation. (Staggered formations are impractical due to the limited field of view of the simulator). You are to maintain 3 to 5 rotor disk separation throughout the flight. I will take the controls at about 3 km's from the LZ and do the approach." Perform a before takeoff check.

TRAINER NOTE: As the aircraft descends through 10 feet, the trainer ensures that the aircraft encounters brownout conditions. Just prior to touchdown, the trainer says, "I've browned out, you have the controls!" He directs the student not to do a go around because of the potential for a collision with Chalks 3 and 4. The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The aircraft took off as Chalk 2 in a flight of four to insert infantry soldiers into an unplanned and unreconned landing zone (LZ). (It was determined that during the air mission briefing there had been undue command pressure exhibited by the ground and air commanders. The crew was relatively inexperienced, the PC having only 12 days of



pilot-in-command time and less than 400 total flight hours.) Upon arrival at the LZ, the crew followed the lead aircraft on approach and conducted a visual reconnaissance on final. The rotor wash of Chalk 1 began to create a dust cloud. As Chalk 2 descended to 10 feet AGL, it entered a brownout condition. Chalks 3 and 4 chose to perform a go around. The PC of Chalk 2 decided to proceed with the landing in an effort to avoid a collision with Chalks 3 and 4. The aircraft landed hard. The crew determined that the landing may have been hard enough to cause damage. While still in the LZ, the crew chief was directed to inspect the aircraft for damage. He noticed a dent, but the PC decided to fly the aircraft back to the airfield. While refueling, the crew chief noticed the tail strut leaking and there was more damage to the aircraft than previously noted. The PI then hovered the aircraft to parking after refueling.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual references. (Dust, sand)
- (2) Aircrew coordination failure.
- (3) Desire to accomplish the mission.
- (4) Poor awareness of the risk of spatial disorientation in the flight conditions.
- (5) Inexperience.
- (6) Organization-imposed task overload.
- (7) Poor mission planning. (Unreconned LZ)

c. "How could this accident be prevented?"

- (1) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations.
- (2) Perform proper aircrew coordination.
- (3) Reconnaissance of landing zones, if possible.
- (4) Perform risk assessment as it relates to crew selection.
- (5) Establish a landing zone go around contingency plan during the premission planning phase.

d. "How could this situation be overcome once you're in it?"

- (1) By performing the briefed landing zone go around contingency plan.
- (2) By performing proper aircrew coordination.

3. If necessary, the trainer will demonstrate the preventive action by:

- a. Performing proper dust landing techniques per the ATM.
- b. Performing proper aircrew coordination.



4. If necessary, the trainer will demonstrate the corrective action by performing a proper go around per the ATM.



SECTION III: NIGHT (UNAIDED)/SINGLE SHIP



SPATIAL DISORIENTATION SCENARIO #8

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Selects NIGHT 2 as the scene illumination.

Scenario Development:

TRAINER READS TO STUDENT: Pre-mission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is a medical transport of two injured patients to a hospital ship located 10 kilometers away on a heading of 180. We are operating in Class G airspace and the weather is 1000 overcast with 2 sm visibility. Winds are calm. I will fly the aircraft and after takeoff from the LZ, I will turn to a heading of 180 and fly at contour flight altitudes (25 to 80 feet) over the water." Perform a before takeoff check.

IO NOTE: As the aircraft crosses the shoreline and begins its overwater segment, the IO will reduce the visibility to 0.1 mile.

TRAINER NOTE: After the visibility is reduced, the trainer slows the aircraft to 70 KIAS and continues flying. After a couple of kilometers, the trainer will begin a slow descent. As the aircraft descends through 30 feet, the IP states, "I have vertigo, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The aircraft was on a night medical transport mission with a crew of four and two patients. The night was very dark with an overcast sky and no natural illumination. Visibility may have been reduced due to rain showers in the area and there were inadequate visual cues to provide information on height above the terrain. The normally dry lake bed over which they were flying was probably covered with water. It is suspected that the aircraft was allowed to descend because of spatial disorientation. The aircraft struck the ground in a wings-level, nose-low attitude at an airspeed of approximately 70 knots. All occupants received fatal injuries and the aircraft was destroyed.

2. Ask the student:

- a. "Why did this happen?" (Solicit feedback from student.)
- b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)



- (1) Lack of or poor visual references. (Overwater, rain, fog, low illumination)
 - (2) Probable visual illusion. (Height perception illusion)
 - (3) Procedures not in accordance with published guidance. (Maintenance of visual flight rules)
 - (4) Aircrew coordination failure.
 - (5) Desire to accomplish the mission. (Medical mission)
 - (6) Improper decision. (Accepting the mission)
- c. "How could this accident be prevented?"
- (1) Follow published guidance and regulations. (Must maintain VFR during all segments of mission: takeoff, enroute, and landing)
 - (2) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations. (Overwater flight)
 - (3) Perform proper aircrew coordination.
 - (4) Perform risk assessment of mission and environmental conditions. (Unaided, overcast, zero moon illumination)
 - (5) Be familiar with potential visual illusions.
- d. "How could this situation be overcome once you're in it?"
- (1) By performing inadvertent IMC procedures per the ATM.
 - (2) By performing proper aircrew coordination.
3. If necessary, the trainer will demonstrate the preventive action by:
- a. Maintaining visual flight rules.
 - b. Performing proper aircrew coordination.
4. If necessary, the trainer will demonstrate the corrective action by performing inadvertent IMC procedures per the ATM.



SECTION IV: NIGHT (AIDED)/SINGLE SHIP



SPATIAL DISORIENTATION SCENARIO #9

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Selects NIGHT 2 as the scene illumination.
3. Sets initial visibility at 1.0 mile.
4. Selects RANDOM VISIBILITY.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Pre-mission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport a patient from this LZ to an airstrip for ground transport to a hospital. The LZ is located in Class G airspace. The weather is 1000 overcast with 1 sm visibility. The winds are calm. After takeoff from the LZ, I (the trainer) will fly a bearing of 278 degrees directly to an airstrip located at 21SVK5800010100, also in Class G airspace. We'll fly at 90 knots and 200 feet AGL." Perform a before takeoff check.

IO NOTE: At approximately 2 minutes after takeoff, the IO will reduce the visibility to 0.1 miles.

TRAINER NOTE: After the visibility is reduced, the trainer will try to convince the student to continue the mission. The trainer will explain that they should just maintain 200 feet and continue to their destination, even though they do not meet visibility requirements. As the flight continues, at some point the trainer will allow the aircraft to begin a rapid descent. As the aircraft descends through 100 feet, the IP states, "I've got vertigo, you have the controls!" The training concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While returning from a patient pickup, on an NVG medical evacuation mission, the crew encountered unforecast instrument meteorological conditions due to fog. Radio transmissions from the aircraft indicated that they continued toward the airfield at approximately 200 feet AGL. Approximately 0.8 miles from the airfield, the crew lost control of the aircraft and allowed the aircraft to descend into the ground at an estimated speed of 80 to 90 knots. The aircraft was destroyed and seven personnel were fatally injured.

2. Ask the student:



- a. "Why did this happen?" (Solicit feedback from student.)
 - b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)
 - (1) Lack of or poor visual references. (Fog)
 - (2) Improper decision. (To continue with mission)
 - (4) Overconfidence in self, crew, and equipment.
 - (5) Desire to accomplish the mission. (Patient transfer)
 - c. "How could this accident be prevented?"
 - (1) By maintaining VFR. (Specifically visibility requirements per class of airspace).
 - (2) If unable to maintain VFR, land, turn back, or accept instrument meteorological conditions and file IFR.
 - d. "How could this situation be overcome once you're in it?"

By performing proper inadvertent IMC per the ATM.
3. If necessary, the trainer will demonstrate the preventive action by maintaining VFR, landing, turning back, or filing IFR.
 4. Demonstrate the corrective action by performing inadvertent IMC procedures per the ATM.



SPATIAL DISORIENTATION SCENARIO #10

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Sets NIGHT 2 as the scene illumination.
3. Sets initial visibility at 1.0 mile.
4. Selects RANDOM VISIBILITY.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page. 6. Selects THUNDERSTORM CONDITIONS on the APU/ELECTRICAL Malfunctions Page.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport troops from this LZ to an airstrip located at 21SVK5800010100. We will be operating in Class G airspace. The weather is 1000 overcast with 1 sm visibility. The winds are calm. After takeoff from the LZ, I will fly at 90 knots and 200 feet AGL on a bearing of 278 degrees directly to the airstrip and insert the troops." Perform a before takeoff check.

IO NOTE: At approximately 2 minutes after takeoff, the IO will reduce the visibility to 0.0 miles.

TRAINER NOTE: As the aircraft takes-off, simulate a call from flight operations similar to the following: "Army 23748, be advised, there is an unconfirmed report of an aircraft mishap in your destination LZ. Provide assistance as necessary if the mishap report is correct." After losing visibility, the trainer states that he is "IIMC" and begins a climb. During the climb, the trainer allows the airspeed to decelerate and simultaneously places the aircraft in an unusual attitude which will simulate the loss of aircraft control. The IP states, "I have vertigo, take the controls." The training concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: During an NVG troop transport service mission, the PC of the aircraft elected to fly into a rain shower because of overconfidence and a strong personal desire to respond to radio calls that led him to believe that another helicopter had just crashed. Upon entering the shower, the PC lost visual reference with the ground, attempted IIMC procedures, lost control of the aircraft and crashed. It was determined that the PC's inexperience and inadequate unit training contributed to this mishap. All nine occupants received fatal injuries and the aircraft was destroyed.



2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual references. (Rain shower)
- (2) Procedures not in accordance with published guidance. (Improper IIMC procedures)
- (3) Desire to accomplish the mission. (Belief that a helicopter had crashed)
- (4) Improper decision. (To proceed into a rain shower)
- (5) Overconfidence in self.
- (6) Inexperience. (The PC)
- (7) Inadequate training. (Probably instrument training)

c. "How could this accident be prevented?"

- (1) Accept instrument meteorological conditions.
- (2) Perform tasks and maneuvers per the ATM.
- (3) Follow published guidance and regulations. (Maintain VFR)
- (4) Perform risk assessment of mission, environmental considerations, and aviator experience.
- (5) Provide necessary unit training.

d. "How could this situation be overcome once you're in it?"

By performing proper inadvertent IMC per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by performing instrument flight per the ATM.

4. If necessary, the trainer will demonstrate the corrective action by performing inadvertent IMC procedures per the ATM.



SPATIAL DISORIENTATION SCENARIO #11

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Sets NIGHT 2 as the scene illumination.
3. Sets initial visibility at 1.0 mile.
4. Selects RANDOM VISIBILITY.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to provide medical assistance to safety and traffic (a MAST mission). There has been an accident involving mass casualties. We are to fly directly to Seaside Airfield located at 21SVK5800010100 and await further instructions on providing transportation of injured personnel to area hospitals. We are departing a landing zone that is in Class G airspace and can expect Special VFR upon arrival at Seaside. SVFR at Seaside is 300 and ½. The weather is forecast to be 1000 overcast with 1 sm visibility for the next 6 hours. Winds are calm. After takeoff from the landing zone, I (the trainer) will fly at 90 knots and 100 feet AGL on a bearing of 280 degrees directly to Seaside Airfield." Perform a before takeoff check.

IO NOTE: At approximately 2 minutes after takeoff, the IO will reduce the visibility to 0.1 miles.

TRAINER NOTE: After the visibility is reduced, the trainer will remark that the weather is too bad to proceed and begins turning left or right in an effort to find better weather. During one of the turns, the trainer allows the aircraft to descend and ensures that the aircraft appears to strike a tree with the rotor system. The IP states, "I think I hit that tree. Take the controls, I'm disoriented!" The training flight concludes when the student recovers or crashes the simulator.

IO NOTE: Upon hearing the trainer say that he thinks he hit a tree, the IO will immediately select the "MAIN ROTOR BLADE DAMPER FAIL" malfunction listed on the ROTOR SYSTEM Malfunction Page in order to induce a main rotor blade vibration.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: During an NVG medical assistance to safety and traffic (MAST) mission, the aircraft was enroute over hilly terrain in marginal weather. The PC became disoriented due to poor visibility and during a turn, the aircraft struck a small tree. After the tree



strike, the aircraft traveled approximately 300 feet before it crashed upright into gradually rising terrain. All four crewmembers sustained minor injuries and exited the aircraft without assistance.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual references. (Fog)
- (2) Procedures not in accordance with published guidance. (Not maintaining VFR)
- (3) Poor awareness of the risk of SD in flight conditions.
- (4) Desire to accomplish the mission.
- (5) Overconfidence in self. (Trying to complete mission in marginal weather)

c. "How could this accident be prevented?"

- (1) Perform tasks and maneuvers per the ATM. (Perform VFR flight)
- (2) Perform risk assessment of mission and environmental considerations.
- (3) Follow published guidance and regulations. (Maintain VFR)
- (4) By landing or turning back when weather is below VFR.

d. "How could this situation be overcome once you're in it?"

By performing proper inadvertent IMC per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by landing when environmental conditions deteriorate below VFR.

4. Demonstrate the corrective action by performing inadvertent IMC procedures per the ATM.



SPATIAL DISORIENTATION SCENARIO #12

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Selects NIGHT 2 as the scene illumination.
3. Sets visibility at 1.0 mile.
4. Selects RANDOM VISIBILITY.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Permission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport a package from this LZ to an airstrip located at 21SVK5800010100. The LZ and the destination airstrip are located in Class G airspace. The weather is 1000 overcast with 1 sm visibility. The winds are calm. After takeoff from the landing zone, you (the student) will fly at 70 knots and at NOE altitudes on a bearing of 278 degrees directly to the airstrip." Perform a before takeoff check.

TRAINER NOTE: If the student objects to flying NOE at 70 knots with NVG's, commend him for his knowledge, and tell him to fly at contour altitudes.

IO NOTE: Approximately 1 minute after takeoff, the IO will select the following malfunction under APU/ELECTRICAL Malfunctions: Battery Fault.

TRAINER NOTE: Upon MASTER CAUTION illumination, the trainer immediately takes control of the aircraft and directs the student to diagnose the CAUTION light. With the student's attention focused inside the cockpit, the IP descends to NOE altitudes. The trainer will also direct his attention inside and allow the aircraft to descend very slowly. As the aircraft descends below 10 feet, the IP states, "I'm all screwed up, take the controls." The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: Approximately 1 minute after takeoff, on an NVG terrain flight mission with the PI on the controls, the master caution light and an undetermined caution segment light illuminated. (The crew consisted of an IP, who was not NVG current and a PI who was not mission trained.) At an estimated airspeed of 70 knots and estimated altitude of 20 feet, an airspeed/altitude combination prohibited by TC 1-210, the IP took the controls. Both the IP and the PI failed to ensure aircraft control by coordinating cockpit duties requiring the P* to maintain visual outside obstacle clearance while the other pilot directs his attention inside the



cockpit. As a result, the aircraft was allowed to descend and impacted a large boulder in an approximate 5-degree nose-high and slight left roll attitude. The crash fatally injured six occupants and seriously injured one. The aircraft was totally destroyed by impact forces and postcrash fire.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

(1) Total disregard for regulations and directives. (Crew not current and/or trained for mission)

(2) Procedures not in accordance with published guidance. (TC 1-210, NVG altitude/airspeed restrictions)

(3) Aircrew coordination failure. (Both crewmembers directed attention "inside")

(4) Overconfidence in self.

(5) Complacency.

(6) Poor awareness of the risk of spatial disorientation in flight under those conditions.

c. "How could this accident be prevented?"

(1) Perform proper aircrew coordination.

(2) Perform tasks and maneuvers per the ATM.

(3) Follow published guidance and regulations.

d. "How could this situation be overcome once you're in it?"

By performing proper aircrew coordination.

3. If necessary, the trainer will demonstrate the preventive action by:

a. Performing proper aircrew coordination.

b. Performing flight tasks per ATM and published guidance, specifically, adhering to NVG altitude/airspeed restrictions.

4. If necessary, the trainer will demonstrate the corrective action by performing proper aircrew coordination. (The P* should remain focused outside, ensuring obstacle clearance, while the pilot not on the controls determines the source of a master caution light.)



SPATIAL DISORIENTATION SCENARIO #13

Simulator Initial Conditions:

The IO:

1. Selects IC#8 (TACTICAL OP NO. 3).
2. Sets NIGHT 2 as the scene illumination.
3. Sets visibility at 1.5 miles.
4. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the scenario IP. Our mission is to perform a local area orientation. This LZ is located in Class G airspace. The weather is 1000 overcast with 1½ sm visibility. Winds are calm. After takeoff from the LZ, I'll turn to a heading of 270 and fly at 70 knots and 100 feet AGL." Perform a before takeoff check.

TRAINER NOTE: The trainer simulates a local area orientation and points out different geographical points to keep the student focused outside the aircraft. Approximately 1 minute after takeoff and over a forested area with limited contrast, the trainer allows the aircraft to ascend to 140 feet and comments that he is at 140 feet and will descend back to 100 feet. The trainer places the aircraft in a 200-feet per minute rate of descent and allows it to descend. As the aircraft descends through 30 feet, the IP asks, "Where's the ground? You have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While in cruise flight, on an NVG local area orientation training flight, the IP, who was on the controls, noted that he was 140 feet AGL. The IP began a descent to return to an altitude of 100 feet AGL as planned for the flight. The IP failed to arrest his descent and impacted a 22-foot high sand dune approximately 5 feet from the crest. The aircraft impacted the ground at 69 knots and at approximately 200 feet per minute rate of descent in a near level attitude. None of the crewmembers noticed the descent or saw the sand dune prior to impact. All crewmembers sustained injuries and the aircraft was totally destroyed.

2. Ask the student:
 - a. "Why did this happen?" (Solicit feedback from student.)



b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual cues. (Terrain with limited contrast)
- (2) Aircrew coordination failure. (No one noticed the descent)
- (3) Perception of linear motion below threshold. (Descent too gradual to perceive.)
- (4) Probable visual illusion. (Height perception illusion)
- (5) Misjudged clearance.
- (6) Poor awareness of the risk of spatial disorientation in those flight conditions.

c. "How could this accident be prevented?"

(1) Perform proper aircrew coordination. (The pilot not on the controls should assist the P* by monitoring the radar altimeter.)

(2) Perform tasks and maneuvers per the ATM applying appropriate environmental considerations.

(3) Maintain situational awareness.

(4) Be familiar with potential visual illusions.

d. "How could this situation be overcome once you're in it?"

(1) By performing proper aircrew coordination.

(2) By performing a go around per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by performing proper aircrew coordination.

4. If necessary, the trainer will demonstrate the corrective action by increasing collective (altitude) as soon as a descent is detected by any crew member. (Basically, perform a go around.)



SPATIAL DISORIENTATION SCENARIO #14

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets NIGHT 2 as the scene illumination.
3. Sets visibility at 1.0 miles.
4. Selects RANDOM VISIBILITY.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PC and I (the trainer) will play the role of the PI. Our mission is to perform a service mission involving the transport of a passenger to an LZ located at 21SWK3000065000 on a heading of 090 from this airstrip. We will be operating in Class G airspace. The weather is 2000 overcast with 1 sm visibility. The winds are calm. After takeoff from the airstrip, I'll turn to a heading of 090 and fly at 70 knots at 50 feet AGL." Perform a before takeoff check.

IO NOTE: After 1 minute, the IO will reduce the visibility to 0.2 sm.

TRAINER NOTE: Once the visibility is reduced, the trainer allows the aircraft to ascend until the ground is not visible. The IP then places the aircraft in a nose-high attitude, decelerates airspeed to near zero and places the aircraft in a descent. The IP states, "I've lost it! You have the controls." The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: The PC decided to participate in an NVG service mission during conditions of zero illumination and limited visibility even though the crew had already exceeded their allowable crew day by 2 hours. The overconfident PC, who was also an experienced NVG IP, thought his proficiency could compensate for the PI's inexperience. During the flight, the PC was unable to recover control of the aircraft after allowing the PI to ascend above an altitude which allowed visual reference with the ground. In his attempt to return the aircraft to the planned altitude and airspeed of 50 feet AGL and 60-70 knots, the PC did not detect a nose-high pitch attitude, which resulted in a deterioration of airspeed and an excessive rate of descent. The aircraft impacted the ground in a near vertical descent with an estimated force of 10 G's. The crew required first aid and the aircraft sustained extensive structural damage.



2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual cues. (Zero illumination, low visibility)
- (2) Perception of linear motion below threshold. (Deceleration too gradual to perceive)
- (3) Possible vestibular illusion. (Oculoagravic illusion)
- (4) Under-reaction. (Too slow to take corrective action)
- (5) Overconfidence in self. (The PC)
- (6) Inexperience. (The PI)
- (7) Poor organizational supervision. (Crew endurance)
- (8) Fatigue. (Exceeded allowable crew day)

c. "How could this accident be prevented?"

- (1) Perform proper aircrew coordination.
- (2) Perform tasks and maneuvers per the ATM.
- (3) Follow published guidance and regulations, to include crew rest/duty day guidelines.
- (4) Maintain situational awareness.
- (5) Be familiar with potential vestibular illusions.

d. "How could this situation be overcome once you're in it?"

- (1) By performing proper aircrew coordination.
- (2) By performing inadvertent IMC procedures per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by performing proper aircrew coordination.

4. If necessary, the trainer will demonstrate the corrective action by performing proper inadvertent IMC procedures per the ATM.

SECTION V: NIGHT (AIDED)/MULTIAIRCRAFT





SPATIAL DISORIENTATION SCENARIO #15

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets NIGHT 2 as the scene illumination.
3. Sets visibility at 1.5 miles.
4. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page. 5. Ensures that "BLOWING SAND AND DUST" is selected.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to be the lead aircraft of a flight of four. The formation will transport troops from this airstrip to a field located at 21SWK2022057800 (8.3 km's away) and return. This airstrip is located in Class G airspace. The weather for our mission, ETA through 1 hour, is 2000 overcast with 1.5 sm visibility. Winds are calm. After takeoff from the airstrip, you will turn to a heading of 165 degrees and fly at 100 knots at 100 feet AGL to the field. At approximately 3 kilometers out, I (the trainer) will take the controls for the landing." Perform a before takeoff check.

TRAINER NOTE: Upon arrival to the brown field, the trainer establishes an approach to the field and turns on the searchlight. The trainer then terminates the approach to a 10-foot hover which results in a brownout condition. The trainer allows the aircraft to begin a drift to the right. The trainer states, "I've lost the ground, you have the controls." The training flight continues until the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: While executing a night approach to a field site with the aid of NVG's and with the searchlight illuminated, the PC of the lead aircraft in a flight of four, terminated the approach to an IGE hover. The crew immediately encountered a brownout condition in rotorwash-induced blowing sand and dust. The aircraft drifted to the right approximately 25 feet before the tail gear and right main gear contacted the ground, inducing a dynamic rollover condition from which the PC could not recover. The aircraft rolled to the right and came to rest in an inverted position. All four main rotor blades, the tailrotor gearbox, and tailrotor blades were separated as they impacted the ground. The four crewmembers sustained minimal injuries.

2. Ask the student:



- a. "Why did this happen?" (Solicit feedback from student.)
 - b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)
 - (1) Lack of or poor visual cues. (Sand, dust, open field)
 - (2) Perception of linear motion below threshold. (Too gradual to perceive)
 - (3) Aircrew coordination failure. (Possibly)
 - (4) Procedures not in accordance with published guidance. (Improper dust landing techniques)
 - (5) Poor mission planning. (LZ selection)
 - (6) Poor awareness of the risk of spatial disorientation in those flight conditions.
 - (7) Self-imposed task overload. (Trying to hover in dust/sand)
 - c. "How could this accident be prevented?"
 - (1) Perform tasks and maneuvers per the ATM, applying appropriate environmental considerations.
 - (2) Perform proper aircrew coordination.
 - (3) Maintain situational awareness.
 - d. "How could this situation be overcome once you're in it?"

By performing a go around per the ATM.
3. If necessary, the trainer will demonstrate the preventive action by:
- (1) Performing a VMC landing, applying dust considerations, per the ATM.
 - (2) Performing proper aircrew coordination.
4. If necessary, the trainer will demonstrate the corrective action by:
- (1) Performing proper aircrew coordination.
 - (2) Performing a go around.



SPATIAL DISORIENTATION SCENARIO #16

Simulator Initial Conditions:

NOTE: This scenario requires the pre-recording of a leadship by the IP or IO. The SFTS is not capable of recording a flight of three aircraft to follow, and therefore, this re-creation will be performed as a flight of two. The leadship will originate at Harris Field (IC#5) and be flown at terrain flight altitude at 100 knots to and landed at the brown field located at 21SWK2022057800. Prior to initiating the recording, taxi the aircraft forward approximately 100 feet. This will place the leadship in front of the simulator as if it were Chalk 1 during the playback and accident re-creation. Ensure that the aircraft exterior lights are set as desired. After landing, continue the recording for approximately 30 seconds so that the leadship doesn't just disappear.

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets NIGHT 2 as the scene illumination.
3. Sets visibility at 1.5 miles.
4. Ensures that "BLOWING SAND AND DUST" is selected.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page. 6. Selects "PLAYBACK" of the appropriate leadship (1, 2, or 3).

Scenario Development:

TRAINER READS TO STUDENT: Permission Briefing- "You (the student) are assigned the role of PC and I (the trainer) will play the role of the PI. Our mission is to be Chalk 2 in a flight of four conducting an NVG training mission. We are departing from an airstrip located in Class G airspace. The weather is 2000 overcast with 1½ sm visibility. The winds are calm. After takeoff from the airstrip, we'll follow the leadship, which will fly at 100 kts and 100 feet, in a trail formation (staggered formations are impractical due to the limited field of view of the simulator) to the LZ located at 21SWK2022057800. We'll maintain 3 to 5 rotor disk separation throughout the flight and during the approach. Since I am the PI and need the training, I'll take the controls about 3 kilometers out and do the approach." Perform a before takeoff check.

TRAINER NOTE: As the aircraft descends through 10 feet, the trainer ensures that the aircraft encounters brownout conditions and adds some left cyclic to induce a drift. The trainer then states, "I can't see the ground, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."



TRAINER READS TO STUDENT: The aircraft was the fourth aircraft in a flight of four conducting an NVG training mission. The PI was at the controls during the final approach into the landing zone. The PI selected a landing point clear of vegetation. During the approach, the PC suggested that the ground speed was too slow. As the approach continued, the crew chief cleared the aircraft to the left side and down. The blowing sand caused the PI to lose visual ground reference. The PC still had reference with the ground and the formation until the tail wheel contacted the ground. The entire crew then lost visibility to blowing sand. The aircraft rolled left and the main rotor blades contacted the ground. The PC took the controls and applied right cyclic and lowered the collective. The aircraft leveled and the crew performed an emergency engine shutdown. There were no apparent injuries to the crew.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

(1) Lack of or poor visual cues. (Sand/dust)

(2) Procedures not in accordance with published guidance. (VMC approach, environmental considerations)

(3) Poor awareness of the risk of spatial disorientation in those flight conditions.

c. "How could this accident be prevented?"

(1) Perform tasks and maneuvers per the ATM.

(2) Perform proper aircrew coordination.

(3) Maintain situational awareness.

d. "How could this situation be overcome once you're in it?"

(1) By performing a go around.

(2) By performing proper aircrew coordination.

3. If necessary, the trainer will demonstrate the preventive action by performing proper VMC approaches using sand/dust landing techniques.

4. If necessary, the trainer will demonstrate the corrective action by performing a go around.



SPATIAL DISORIENTATION SCENARIO #17

Simulator Initial Conditions:

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets NIGHT 2 as the scene illumination.
3. Sets initial visibility at 1.5 miles.
4. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PC and I (the trainer) will play the role of the PI. Our mission is to be the lead aircraft of a flight of three conducting NVG formation flight training within the local area. The airstrip is located in Class G airspace and the weather is 2000 overcast with 1½ sm visibility. Fog is reported in low-lying areas. Winds are calm. After takeoff from the airstrip, you (the PC) will turn to a heading of 090 and fly at 100 knots at 100 feet AGL. Once established, you will transfer the controls to me (the PI). The flight route will consist of flight legs of about 2 minutes on the compass cardinal headings (090, 360, 270, 180) and then back to the airstrip." Perform a before takeoff check.

IO NOTE: When the trainer is midway through the turn to the north, the IO reduces visibility to 0.0 miles. The IO will also be prepared to assume the role of ATC and clear the aircraft to 2000 feet and heading 360.

TRAINER NOTE: After losing visibility, the trainer will announce "Inadvertent IMC," turn left to heading 360, and climb to 2000 feet. The IP will then direct the student to squawk emergency and contact approach control on a particular frequency. While the student is changing the frequencies, the trainer will slowly reduce the airspeed to zero and lower the collective. The trainer then states, "I have vertigo, you have the controls!" The training flight continues until the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: During an NVG tactical terrain flight, the lead aircraft in a flight of three encountered IIMC. The crew initiated IIMC procedures and made a climbing left turn to 4000 feet. During the climb, they squawked emergency on the transponder and were monitored by radar. At 4000 feet, the airspeed dropped to near zero and the aircraft entered into an uncontrolled rate of descent. The aircraft impacted in a 20-30 degree nose-low, 30 degree roll, and a 15 degree yaw attitude. Forward airspeed exceeded 60 knots. The aircraft was



destroyed and the crew members received fatal injuries. (The aircraft involved in this accident was an OH-58A which is not an IFR certified aircraft. There was a crew of two.)

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

- (1) Lack of or poor visual cues. (Fog)
- (2) Poor aircraft instrumentation. (OH58)
- (3) Aircrew coordination failure. (Division of cockpit duties)
- (4) Perception of linear motion below threshold. (Too gradual to perceive)
- (5) Inexperience (In instrument flight).
- (6) Inadequate training. (Typical of OH58 pilots)
- (7) Poor awareness of the risk of SD in flight conditions.

c. "How could this accident be prevented?"

- (1) Perform tasks and maneuvers per the ATM. (Instrument flight)
- (2) Perform proper aircrew coordination.
- (3) Improve/increase instrument training.

d. "How could this situation be overcome once you're in it?"

- (1) By performing inadvertent IMC procedures per the ATM.
- (2) By performing instrument tasks per the ATM.

3. If necessary, the trainer will demonstrate the preventive action by:

- (a) Performing proper aircrew coordination.
- (b) Maintaining instrument tasks within ATM standards.

4. If necessary, the trainer will demonstrate the corrective action by:

- (a) Performing inadvertent IMC procedures per the ATM.
- (b) Performing instrument tasks per the ATM.



SPATIAL DISORIENTATION SCENARIO #18

Simulator Initial Conditions:

NOTE: This scenario requires the pre-recording of a leadship by the IP or IO. The leadship will originate at Harris Field (IC#5) and be flown on heading 180 at 100 knots and 200 feet AGL for 5 minutes. Prior to initiating the recording, ensure external lights are illuminated and taxi the aircraft forward approximately 100 feet. This will place the leadship in front of the simulator as if it were Chalk 1 during the playback and accident re-creation.

The IO:

1. Selects IC#5 (TACTICAL - HARRIS FIELD).
2. Sets NIGHT 2 as the scene illumination.
3. Sets visibility at 1.0 miles.
4. Ensures that "BLOWING SAND AND DUST" is selected.
5. Selects IR FILTER INSTALLED on the AIRCRAFT CONDITIONS Page.
6. Selects "PLAYBACK" of the appropriate leadship (1, 2, or 3).

Scenario Development:

TRAINER READS TO STUDENT: Prepermission Briefing- "You (the student) are assigned the role of PC and I (the trainer) will play the role of the PI. Our mission is to be Chalk 2 in a flight of two performing a formation flight service mission in the local area. We are operating in Class G airspace. The weather is 2000 overcast with 1 sm visibility. The winds are calm. After takeoff from the airstrip, we'll follow the leadship in a trail formation. (Staggered formations are impractical due to the limited field of view of the simulator). The leadship will fly heading 180 at 100 knots, 200 feet. We are responsible for the flight following and a call to operations is due in about 3 minutes. We'll maintain 3 to 5 rotor disk separation throughout the flight." Perform a before takeoff check.

TRAINER NOTE: After approximately 2 minutes, the trainer directs the student to initiate a fuel consumption check in order to ensure the student's focus is inside the cockpit. Meanwhile, the trainer performs a frequency change and attempts a radio call (for flight following) during which he places the aircraft in a gradual descent, ignoring the leadship. As the aircraft descends through 30 feet, the trainer states, "I've lost the leadship, you have the controls!" The training flight concludes when the student recovers or crashes the simulator.

Debriefing:

1. Tell the student, "That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. The following is a summary of the actual spatial disorientation accident."

TRAINER READS TO STUDENT: During an NVG service mission at 200 feet AGL at 100 knots, the PI of Chalk 2, in a flight of two aircraft, is suspected of allowing the aircraft to



descend and impact the ground in a 3-degree nose-up and 5 degree left roll attitude. Moments prior to the accident, the PI, who was on the controls, was directed to make a radio transmission that required specific cockpit tasks, such as changing frequencies. As a result, the crew failed to properly perform crew coordination actions.

2. Ask the student:

a. "Why did this happen?" (Solicit feedback from student.)

b. "What factors made spatial disorientation more likely in this situation?" (The following list is not all inclusive.)

(1) Aircrew coordination failure. (Improperly focused attention)

(2) Perception of linear motion below threshold. (Descent too gradual to perceive)

c. "How could this accident be prevented?"

By performing proper aircrew coordination.

d. "How could this situation be overcome once you're in it?"

(Not applicable to this scenario.)

3. If necessary, the trainer will demonstrate the preventive action by performing proper aircrew coordination.

4. If necessary, the trainer will demonstrate the corrective action by: (Not applicable to this scenario.)



Summary

Spatial Disorientation in aviation is a product of the relationship of human physiology to the complex flight environment. There is no option to modify the physiological responses of aircrew in order to avoid SD. The accessible route to reducing the number of SD accidents is to increase awareness of the problem in the Army's pilot population and in this way reinforce lessons from flight training to improve the response of crews when faced with potential or actual SD.

The aim of this proposed training program is to heighten awareness of SD in the aviation community by demonstrating the problem in a controlled environment, but in a very realistic manner, using data taken directly from real SD accidents. This enables the trainer to take the aviator through the scenario and use the experience as a basis for reinforcing the principles of good situational awareness and aircrew coordination through a structured debriefing process.

USAARL is confident that the scenarios presented contain valuable training material, and will have a positive impact on reducing SD mishaps. Our liaison with the U.S. Army Safety Center ensures that the scenarios reflect, as far as possible, the actual accident and that the scientific background to the scenarios and the associated debrief is sound.

The eighteen scenarios have been validated in the USAARL simulator, and it is proposed that USAARL continue to monitor the package to assess the impact on attitudes and practice after distribution. It is vital that the scenarios are not viewed in isolation, but as the central part of a complete training package which is part of the larger training process. To ensure that the intended benefits are realized from this training, it is important that the package is maintained intact and implemented as designed and validated.

The intention is that the scenarios will be reviewed periodically in consultation with the U.S. Army Safety Center and other agencies. USAARL will continue to produce new scenarios and scripts in response to the Army's accident trends, ongoing research, and evaluation of the training package's practical use in the field.



Appendix A.

Abbreviations and Definitions.

ATM	Aircrew Training Manual
AGL	Above Ground Level
FARP	Forward Area Refueling Point
IFR	Instrument Flight Rules
IGE	In Ground Effect
IIMC	Inadvertent Instrument Meteorological Conditions
IMC	Instrument Meteorological Conditions
IO	Simulator Instructor/Operator
IP	Instructor Pilot
MSL	Mean Sea Level
NOE	Nap-of-the-Earth
NVG	Night Vision Goggles
OGE	Out of Ground Effect
P*	Pilot on the controls
PC	Pilot-in-Command
PI	Pilot
SD	Spatial Disorientation
sm	Statute mile
SP	Standardization Instrument Pilot
Trainer	SP, IP, UT, or IO
UT	Unit Trainer
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions