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Mitigating Susceptibility to Disorientation through Immersive Operant Conditioning

By Michael L. Wilson, Arthur Estrada, Amanda Kelley, Melody R. King, Jim A. Chiaramonte, Michael D. Shorter, Shawn A. Kirby

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Warfighter Performance Group

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14. ABSTRACT
The purpose of this study was to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to Spatial Disorientation (SD) accident-based flight scenarios on the performance of rated aviators in the recognition and prevention of SD accidents. The study population was comprised of 30 rated UH-60 Black Hawk aviators, recruited from personnel assigned to USAACE, Fort Rucker, AL. Participants were randomized and assigned to one of two groups, experimental or control. The data indicate that conducting scenario-based SD training has an effect on a pilot's ability to recognize situations that have led to aircraft accidents in the past. Further, there is an observable change in behavior in order to avoid situations that would likely result in SD accidents in the future. Based on this study, the authors recommend that the Army incorporate accident-based scenarios into continuation training requirements in the flight simulator for aviation personnel. This will aid in the prevention of SD accidents.

15. SUBJECT TERMS
Spatial Disorientation. Flight Simulator, Scenario-based training, operant conditioning, SD mitigation

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Summary

Eighty percent of rotary wing aircraft losses and 70% of aircrew fatalities during Operation Iraqi Freedom and Operation Enduring Freedom (OIF,OEF) were due to non-combat factors, including degraded visual environment (DVE) (CONOPS for Aircraft Operations in DVE, 4 April 2011, USAACE CRD). More than a third of all helicopters lost in Iraq and Afghanistan have crashed because of disorientation due to brownout or controlled flight into terrain. One hundred three Americans died in Army helicopter crashes attributed to DVE conditions in the last decade. The purpose of this study was to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to spatial disorientation (SD) accident-based flight scenarios on the performance of rated aviators in the recognition and prevention of SD accidents.

This study evaluated the efficacy of the immersive operant conditioning using a between-subjects design. The study population was comprised of 30 rated UH-60 Black Hawk aviators, recruited from personnel assigned to United States Army Aviation Center of Excellence (USAACE), Fort Rucker, AL. Participants were randomized and assigned to one of two groups, experimental or control. Researchers at USAARL updated the Estrada, et al. (1998) scenarios in order to provide a set of four conditioning and four evaluation scenarios used in this study. The scenarios are included as Appendix A (Experimental Group) and Appendix B (Control Group).

The data show that 79% of the occurrences of SD were in the group of pilots who had not received training on the SD scenarios. The primary outcome measure was the SD level rating, which ranged from 0 (no SD) to 4 (catastrophic). Given the ordinal nature of the rating scheme, data were analyzed using a chi-squared test of association between group (control and experimental) and SD level rating was significant suggesting the likelihood of observed SD was greater for the control group than the experimental group, $\chi2(3) = 5.18$, $p = 0.02$. This indicates that conducting scenario-based SD training has an effect on a pilot's ability to recognize situations that have led to aircraft accidents in the past and change their behavior in order to avoid situations that would likely result in future accidents.

In conclusion, the purpose of this study was to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to SD accident-based flight scenarios on the performance of rated aviators in the recognition and prevention of SD accidents. The data indicate that conducting scenario-based SD training has an effect on a pilot's ability to recognize situations that have led to aircraft accidents in the past. Further, there is an observable change to or in their behavior in order to avoid situations that would likely result in SD accidents in the future. Based on this study, the authors recommend that the Army incorporate flight simulator accident-based scenarios into training requirements for aviation personnel. This will aid in the prevention of SD accidents.

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Introduction

The purpose of this study was to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to spatial disorientation (SD) accident-based flight scenarios on rated aviators' performance in the recognition and prevention of SD accidents. Eighty percent of rotary wing aircraft losses and 70% of aircrew fatalities during Operation Iraqi Freedom and Operation Enduring Freedom were due to non-combat factors, including a degraded visual environment (DVE) (CONOPS for Aircraft Operations in DVE, 4 April 2011, USAACE CRD). More than a third of all helicopters lost in Iraq and Afghanistan have crashed because of disorientation due to brownout or controlled flight into terrain. In the last decade, 103 Americans were killed in Army helicopter crashes attributed to DVE conditions.

The United States Army Aviation Center of Excellence (USAACE), United States Army School of Aviation Medicine (USASAM), and the United States Army Combat Readiness Center (USACRC) are examining methods to reduce the risk of SD of flight crews into conditions that make SD (and its associated cognitive impairment (Gresty, Golding, Le, & Nightingale, 2008)) more likely to occur. One method of particular interest to them is that of immersive scenario-based training (conditioning) as a method of mitigating SD. Their experience in developing and assessing accident mitigation strategies, led to a request for USAARL to assist in determining the efficacy of such conditioning. According to Cherry (n.d.), operant conditioning focuses on using either reinforcement or punishment to increase or decrease a behavior. Through this process, an association forms between the behavior and the consequences for that behavior. In operant conditioning, incentives are the learners reward. An action by the active participant is required to receive an award or punishment. It requires the learner to actively participate and perform some type of action for reward or punishment. Operant conditioning is achieved through immersive learning. According to Pagano (n.d.), in immersive learning, the learners controlled experiences, feedback they receive, and the opportunities they have, allow them to see both short-term and long-term consequences of their actions (or inactions).

Estrada, A., Braithwaite, M. G., Gilreath, S. R., Johnson, P. A., and Manning, J. C. 1998. developed flight scenarios that recreated the operational, environmental, and flight conditions of flights that resulted in actual aviation mishaps with disorientation as a contributing factor. The scenarios received wide acclaim from the user community (operational aviation units) and were highly rated by 30 subjective aviators in a study by Johnson, Estrada, Braithwaite, and Manning (1999). A USACRC representative requested USAARL update the SD scenarios from Estrada, et al. (1998) based on recent accidents resulting in a November 2014 (FY15) Working Group (with representatives from USAACE, USACRC, and USASAM) to revisit scenario-based training. Before implementing a regulatory, costly conditioning program (in terms of time and funding resources), USAACE requested scientific evidence that the conditioning is effective in mitigating susceptibility to disorientation and reducing poor decisions by aviators. This study used accident-based scenarios to condition an experimental group of pilots. The reward was the successful completion of the mission, whereas the punishment was the chance of crashing the simulator.

Methods and Materials

Design

In this study, a between-subjects design evaluated the efficacy of the immersive operant conditioning. Researchers at USAARL updated the Estrada, et al. (1998) scenarios in order to provide a set of four conditioning and four evaluation scenarios used in this study. The scenarios are included as Appendix A (Experimental Group) and Appendix B (Control Group). In order to determine the sample size required to achieve a sufficient power to examine the potential of the immersive operant conditioning, a power analysis using the DSS Research calculator, an online power calculation tool (DSS Research, n.d.). The power calculation was conducted specifying a desired power of .80, an alpha level of .05 and a large effect size (d = 1.00). The large effect size of 1.00 resulted from a study by Carney and Levin (2003). Carney and Levin's work examined the effects of training undergraduate students in the use of mnemonic strategies (pictorial representations) on their memory and recall of unfamiliar hierarchical information, which is sufficiently similar to the objectives of the present study. With these specifications and Carney and Levin's findings as a basis for the power calculation, 30 participants (n=15 in the experimental group and n=15 in the control group) will be required to ensure an 80% chance of rejecting a false null hypothesis. Hence, this study required a total n=30 participants.

Participants

The study population was comprised of 30 rated UH-60 Black Hawk aviators. Participants were recruited from personnel assigned to USAACE, Fort Rucker, AL, and were identified through local advertisement and solicitation. Fort Rucker is the location of the Army's flight school. Participants were assigned to one of two groups, experimental and control. Both groups were consented and completed a demographics questionnaire prior to their flight.

Table 1. Study Group Demographic Summary

Demographic Element	Combined *(M / SD)*	Experimental Group *(M / SD)*	Control Group *(M / SD)*
Age (years)	35.6/5.5	37.4/6.8	33.7/2.9
Experience (years)	8.4/3.8	9.4/4.4	7.4 /2.9
Total RW Hours	1697/873	1917/1080	1477/556
Total SFTS Hours	297/220	318/233	276/212
Flight Hours (past 6 mos.)	119/70	108/73	130/67

Note. No statistical difference found between experimental and control groups, $p \leq .05$, (two-tailed).

Procedures

The USAARL NUH-60 Research Simulator was used to conduct all training and testing for this study. All participants flew the scenarios from the left pilot's seat, and utilized the cockpit layout of a UH-60L series aircraft. A USAARL Research Pilot occupied the right pilot's seat, provided the mission briefings, and served as the second rated crewmember for all flights.

The experimental group began by flying four conditioning scenarios. The scenarios progressed as written, ending with the objectives met or the simulator crashed. After completion, the scenarios were debriefed and the pilots reviewed their performance. The debriefing template contained various learning points (e.g., weather, crew coordination elements, decision-making, etc.) which are included in the scenarios. The conditioning flights lasted approximately one hour. Following the conditioning flights, participants flew four additional evaluation scenarios. The evaluation flights took approximately 1 hour to perform as well. Randomization of the evaluation scenarios prevented order effects. Performance on the evaluation scenarios used an outcome-based grading rubric (Appendix C); however, the participant did not receive a debriefing. The same UH-60 Instructor Pilot graded all evaluation scenarios.

The control group began their flight period with a scripted one-hour flight (script included in Appendix C). This flight included a takeoff, climbs, turns, descents, and a landing in order to balance the flight times with the training provided to the experimental group. Following the training flights, participants flew the same four one-hour evaluation scenarios as described in the experimental group above. Following the evaluation flights, a discussion took place with the participant explaining the purpose of the study and the role they played. After answering all questions, each off-duty participant received a $100 gift card as compensation for their time.

The primary outcome measure was the spatial disorientation level rating, which ranged from 0 (no SD) to 4 (catastrophic). Given the ordinal nature of the rating scheme, data were analyzed using a chi-squared test of association between group (control and experimental) and *spatial disorientation level rating*.

Results

Initial examination of the *spatial disorientation level ratings* showed limited variability. Specifically, 30 participants completed four scenarios resulting in 120 *spatial disorientation level ratings*. Of these 120 ratings, 106 were zero indicating no SD (88.3%). Given this, data were categorized as "no SD" (rating equal to 0) and "SD" (any ratings greater than 0). Of the 14 SD observations, 11 were in the control group and three in the experimental group. A chi-square test of association between group and SD presence/absence was significant suggesting the likelihood of observed SD was greater for the control group than the experimental group, $\chi^2(3) = 5.18$, $p = 0.02$.

Discussion

This study aimed to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to SD accident-based flight scenarios on the performance of rated aviators in the recognition and prevention of SD accidents. Each of the simulator-based scenarios used for the control and experimental group depicted accidents in the operational Army.

The data show that 79% (11/14) of the occurrences of SD were in the group of pilots who had not received training on the SD scenarios. This indicates that conducting scenario-based SD training has an effect on a pilot's ability to recognize situations that have led to aircraft accidents in the past and leads to change in a their behavior in order to avoid situations that would likely result in accidents in the future. Additionally, many of the subjects remarked about the utility of scenarios like those used in this study for crew coordination or pilot-in-command training in the simulator.

Researchers were unable to induce vestibular-based SD due to the limitations of the RUH-60 simulator (2B-39). As a result, the scenarios used in this study induced SD by reducing flight visibility levels while increasing workload (requesting information from the pilot, asking them to make radio calls, etc.). Eighty-eight percent (106/120) of the scenarios resulted in no SD. This may be due to the large number of rated instructor pilots recruited (23/30), who routinely train and evaluate crew coordination fundamentals. Additionally, it is possible that crew coordination fundamentals have become integrated into the Army aviation culture. The authors suggest additional studies in the future in order to evaluate the overall success of the Army aircrew coordination education program.

Recommendations

Based on the results of this study, the authors recommend that the Army incorporate accident-based scenarios into continuation training requirements to aid in the prevention of SD accidents. This study did not examine the frequency of SD training.

Conclusions

In conclusion, the purpose of this study was to evaluate the efficacy of immersive operant conditioning in the form of repeated exposure to SD accident-based flight scenarios on the performance of rated aviators in the recognition and prevention of SD accidents. The data indicate that conducting scenario-based SD training has an effect on a pilots ability to recognize situations that have led to aircraft accidents in the past. Further, there is an observable change in their behavior in order to avoid situations that would likely result in SD accidents in the future.

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Mitigating Susceptibility to Disorientation Through Immersive Operant Conditioning

Mission Scenarios

Control Group Scenarios

Settings for Low workload condition:

1. **Runway Beacon/ Lighting ON**
2. **0600 hrs, July 11th**
3. **Continuous time of day**
4. **10 miles visibility**

#	MANEUVER DESCRIP-TION	HEADING (degrees)	ALT (feet)	RATE OF CLIMB/ DESCENT (feet per min)	AIR SPEED (knots indicated)	TIME (mins)
1	Stationary Hover Power Check	180	10 AGL	0	0	2
2	Takeoff	187	10 AGL to 2000 MSL	+500	0 to 80	3
3	Straight and Level Acceleration	187 (to Hound Intersection)	2000 MSL	0	80 to120	6
4	Right Standard Rate Turn	From 187 to 253	2000 MSL	0	120	0.5
5	Straight and Level	253	2000 MSL	0	120	10
6	Right Standard Rate Turn	From 253, two 360 degree turns for spacing	2000 MSL	0	120	4

7	Straight and Level	253	2000 MSL	0	120	5
8	Straight Climb	253	2000 MSL to 3000 MSL	+500	120	2
9	Straight and Level	253	3000 MSL	0	120	8.5
10	Left 433 degree Descending Standard Rate Turn	From 253, 433degree turn for spacing, roll out on 180, descend to 2000	3000 MSL to 2000 MSL	-500	120	3
11	Straight and Level	180	2000 MSL	0	120	6
12	Straight Descent	180	2000 MSL to500 MSL	-500	120	3
13	Straight and Level Deceleration	180	500 MSL	0	120 to 80	3.5
14	VMC Approach and Landing	170	500 MSL to Runway 17	As desired	80 to 0	2

SIM CONTROL Quick Guide (Condition Locations):

Runway Beacon/ Lighting ON

Current conditions -> Lighting -> Set all three settings to 5 and Select Beacon and Strobe

0600 hrs, July 11th

Current Conditions -> Environment -> Scene Illumination -> Enter 0600 July 11

Continuous time of day

Current Conditions -> Environment -> Touch Continuous Time of Day

10 miles visibility

Current Conditions -> Environment -> Visibility -> Enter 10

Spatial Disorientation Scenario #1- Evaluation

Undetected Drift/Descent – Overwater

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - HOONAH
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 1 statute mile
4. Sets RANDOM VISIBILITY
5. Sets Ceiling (Clouds) at 1000 feet overcast
6. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) 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 that's not really how we fly in this unit, and I don't think it's necessary. 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 024 degrees. I'll show you an island which is located about 13 kilometers northeast of here (N 58:10.73 / W 135:15.47) 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."

IO NOTE: Once over the water, add precipitation and begin to decrease the visibility incrementally to .25 SM.

TRAINER NOTE: 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, $#*+!, WHATS MY ALTITUDE??... I NEED HELP!" The training flight concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #2- Evaluation

Inadvertent IMC

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - JUNEAU
2. Sets Scene Illumination – NOON
3. Sets Visibility at 1 statute mile
4. Sets Ceiling (Clouds) at 1000 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport troops from the airfield to an LZ located at (8V NK 3569 6094). 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; maintaining runway heading to pick up the southeastern river valley. Then we will proceed directly to the airstrip and insert the troops." Perform a before takeoff check.

TRAINER NOTE: Shortly after the aircraft takes-off, simulate a call from flight operations similar to the following: "Blackhawk 123, Phoenix X-Ray, be advised – there is a report of a possible aircraft mishap in vicinity of your destination LZ. Please move to that location, report findings and serve as on-scene commander as necessary."

IO NOTE: At approximately 2 minutes after takeoff, the IO will enable PRECIPITATION and begin to incrementally reduce the visibility to 0.5 SM. At approximately 2 km to LZ, reduce the visibility to 0.0 SM.

TRAINER NOTE: 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, can you take the controls??" The training concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #3- Evaluation

Undetected Drift/Descent

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - IC8
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 2 statute miles
4. Sets Ceiling (Clouds) at 1000 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) 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 approximately 10 kilometers away at GRID 8V ML 91010 13476 . 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 300 and fly at contour flight altitudes (25 to 80 feet) over the water." Perform a before takeoff check.

IO NOTE: After 2 minutes begin incrementally decreasing the visibility down to 0.9 SM.

TRAINER NOTE: After the visibility is reduced, the trainer slows the aircraft to 70 KIAS and continues flying. After a couple of kilometers, direct the participant to tune the radio to the ship frequency (FM 32.150). Then, the trainer will begin a slow descent into the water while the participant is still focused inside. The training flight concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #4- Evaluation

Decreasing Visibility

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - JUNEAU
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 2 statute miles
4. Sets Ceiling (Clouds) at 1200 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to conduct a critical resupply of ammo and water to OP SPEAR (8V NK 35687 60942). They've been taken fire all day, and we have got to get these supplies to them or they are as good as gone. The weather is 1200 overcast with 2 SM visibility. Winds are calm. I will fly the aircraft and after takeoff from the airfield, I will proceed on course and fly at 1000' AGL and 120 knots to the OP" Perform a before takeoff check.

IO NOTE: After approximately 2 minutes after departure, reduce the visibility to 1 SM and ceiling to 1000' OVC. Do not lower the ceiling to the point that the A/C goes IIMC.

TRAINER NOTE: After the visibility is reduced, the trainer will descend and slow down as necessary to continue the flight to the OP. If the participant mentions the weather decreasing, continue to push the need to complete the mission.

IO NOTE: After two more minutes, reduce the visibility to 0.7 SM.

TRAINER NOTE: At this point, make the decision to return to base due to weather. However, do not commit to IFR; attempt to reverse course and maintain VFR enroute to home station.

IO NOTE: After approximately 1 minute, reduce visibility to 0.3 SM.

TRAINER NOTE: Begin a slow increase in pitch until zero airspeed is reached. Continue to pitch up until aircraft begins to descend backward at a high rate of speed. The trainer will repeat, "I've got it… I've got it…" until the participant takes the controls, or the aircraft impacts the ground. The training flight concludes when the participant recovers or crashes the simulator.

Mitigating Susceptibility to Disorientation Through Immersive Operant Conditioning

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Mission Scenarios

Experimental Group Scenarios

Spatial Disorientation Scenario #1- Training

Undetected Drift/Decent – Overwater

Simulator Initial Conditions:

The IO:

1. Selects ALASKA – GUSTAVUS
2. Sets Scene Illumination – (10 JAN – 0800). Sets Visibility at 1 statue mile
4. Sets Ceiling (Clouds) at 400 feet overcast
5. Winds are 090 at 15 knots6.

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to conduct a dual ship, helocast mission in order to insert a NSWG team onto a zodiac in the nearby bay to the South during evening hours. We are briefed on the Risk Assessment Matrix for 1000 foot ceiling and three statue miles visibility. The current conditions are 400 foot overcast with one statue mile visibility. Because of our unit's "no fail" mentality we will accomplish this mission. We will start as the lead ship at the Gustavus Airport on the ground. The flight route will consist of flying to the start point on a cardinal heading of 180 for approximately three minutes, followed by a left turn to 090 in order to set you up for a short final to insert the NSWG team onto the Zodiac.

TRAINER NOTE: At this point, if the trainee does not want to takeoff due to weather commend them for that; however as the PC try to pressure them to get the mission done due to it only being a five minute flight and you are eager to get home. You the trainer will start on the controls and fly to the start point and make the turn to a 090 heading. Before making the turn, you will direct the participant to look inside to tune the radio for the ground force on FM 36.750 and verify the GPS coordinate for the zodiac boat. As this is happening, continue the left turn while starting a slow climb and deceleration until you are reading zero knots forward airspeed and begin to hover aft.

If the PARTICIPANT recognizes the spatial disorientation, allow them to take the controls to correct the aircraft. If the PARTICIPANT does not recognize that you are spatially disoriented, tell them "I think I'm disoriented" and transfer the flight controls to the PARTICIPANT being trained. When you get out over the water, the participants will have trouble discerning the difference between the water and the horizon due to the ceiling and weather degrading and the lack of visual cues over water. If he or she is able to notice their position in relation to the earth's surface, he or she will execute an

IIMC recovery and, in an advanced cockpit, will use one of the slow recovery methods and couple the flight director (this flight will begin in uncoupled flight). The training flight continues until the trainee recovers or crashes the simulator.

Debriefing:

1. Tell the participant, “That was spatial disorientation. The situation we just experienced actually occurred and resulted in an aircraft mishap. All crew members and passengers were fatally injured in this mishap.

2. Ask the participant:

a. “Why did this happen?” (Solicit feedback from the participant.)

b. “What factors increased the likelihood of spatial disorientation in this situation?” (The following list is not all inclusive.)

1) Lack of visual cues. (Fog / Water)
(2) Aircrew coordination failure. (Division of cockpit duties)
(3) Unit Culture
(4) Overconfidence.
(5) Procedures not per published guidance.
(a) Failure to Maintain Airspace Surveillance (Task 1026)
(b) Failure to respond to Inadvertent Instrument Meteorological Conditions (Task 1184)
(c) Failure to perform Flight Director Operations (Task 1169)
(d) Failure to perform Unusual Attitude Recovery (Task 1182)

c. “How could this accident be prevented?”

(1) Perform tasks and maneuvers per the ATM.
(2) Perform proper aircrew coordination.
(3) Perform pre-mission flight planning and receive weather from a military briefer.

d. “How could this situation be overcome once you are in it?”
(1) By performing IIMC procedures per the ATM.
(2) By engaging the Flight Director and engaging one of the slow recovery modes.

Spatial Disorientation Scenario #2-Training

Inadvertent IMC

Simulator Initial Conditions:

The IO:

1. Selects ALASKA – GUSTAVUS
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 1 statute mile
4.
5. Sets Ceiling (Clouds) at 2000 feet overcast
6. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to conduct an urgent MEDEVAC mission from a nearby FOB and bring them back to the Role 3 here. We are chalk one in a flight of two. The weather is 2000 overcast and 1 SM visibility. The winds are calm. After takeoff from the LZ, I will begin a climb and fly to the Southeast and then follow the shoreline to the East to the PZ at 120 knots and 1000 feet AGL. You will take the controls for the return leg." Perform a before takeoff check.

IO NOTE: When the TRAINER announces the "slight left turn", allow them to begin the turn and then turn CRASH OVERIDE ON to prevent the simulator from crashing due to the excessive turn rate. Turn the CRASH OVERIDE OFF if/when the aircraft contacts the ground/water.

TRAINER NOTE: Shortly after the aircraft takes-off, begin talking about how low the visibility is outside. At approximately 2 minutes after takeoff and while flying along the shoreline, begin a 1,000 fpm rate of descent. Quickly catch your mistake (if the participant does not) and return to 1000' AGL. Soon after, direct the participant to adjust your instrument lights because, "they are too dark, and I can't see them". While the participant is distracted, announce a "slight left turn" and begin a slow left bank increasing the roll rate until the aircraft is inverted and pitched steeply down. The trainer announces, "Oh my god! … I'm disoriented! You have the controls!" The training concludes when the participant recovers or crashes the simulator.

Debriefing:

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

2. “While flying as a medical evacuation chase aircraft using night vision goggles and under zero illumination over flat desert terrain, Chalk 2 climbed to approximately 1,000 feet above ground level and entered a steep left bank, followed by a rapid descent. The aircraft impacted the ground at an approximate 90 degree bank and 34 knots airspeed. The aircraft immediately caught fire, which destroyed the aircraft. The four crew members sustained fatal injuries. At the time that the aircraft began to invert, the two PCs were discussing aborting for weather.”

3. Ask the participant:

a. “Why did this happen?” (Solicit feedback from the participant.)

b. “What factors increased the likelihood of spatial disorientation in this situation?” (The following list is not all inclusive.)

(1) Failure to commit to IMC.

(2) Lack of visual cues. (Zero Illumination / Low contrasting terrain)

(3) Desire to accomplish the mission

(4) Overconfidence.

(5) Aircrew Coordination Failure (Coordinate / Prioritize Actions)

c. “How could this accident have been prevented?”

(1) Accept IMC conditions.

(2) Remove emotions from decision process.

(3) Perform risk assessment of mission, environmental considerations, and aviator experience.

d. “How could this situation be overcome once you are in it?”

(1) Performing proper IIMC procedures (Task 1184) per the ATM.

(2) Cross-monitor performance.

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

a. Landing or RTB when VFR cannot be maintained.

b. Performing proper IIMC procedures.

Spatial Disorientation Scenario #3- Training

Undetected Drift/Decent

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - GUSTAVUS
2. Sets Scene Illumination – Noon
3. Sets Visibility at .5 statute miles
4. Sets Ceiling (Clouds) at 2000 feet overcast
5. Winds Calm
6. Sets DUST – 4
7. Request Snow Conditions (temp below freezing and precipitation – on). (Some simulators are not capable of creating snow conditions. In such cases, dust conditions may be substituted.)

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – ""You (the participant) are assigned the role of PC, and I (the trainer) will play the role of the PI. Our mission is to perform annual snow/dust qualifications in snow/dust conditions just northwest of the runway in North Sod. We had a company ship doing snow/dust qualifications earlier today and reported only light snow/dust accumulation. 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 North Sod. After receiving clearance, I will take off to a hover, conduct a 180-degree pedal turn and hover taxi the aircraft, at 50 feet above ground level (AGL) to North Sod. At the end of the runway, I will turn to heading 320 and taxi approximately 300 meters to the sod located at 08V MK 5797 7755 ." 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. Begin the first landing sequence; once the A/C is in whiteout conditions direct the participant to assist in setting the parking brake. While the participant'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 participant becomes aware of the dangerous situation, the trainer states, "I got it, I'm fine, I'm fine, I got it!" The training flight concludes when the participant recovers or crashes the simulator.

Debriefing:

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

2. “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.”

3. Ask the participant:

a. “Why did this happen?” (Solicit feedback from the participant.)

b. “What factors increased the likelihood of spatial disorientation in this situation?” (The following list is not all inclusive.)

(1) Lack of good visual cues. (Fog / Blowing Snow)

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

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

(4) Improper response with aircraft controls. (Excessive control inputs)

(5) Overconfidence.

(6) Poor awareness of the risk of SD in flight conditions.

c. “How could this accident have been prevented?”

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

(2) Perform proper aircrew coordination.

d. “How could this situation be overcome once you are in it?”

(1) Perform Go-Around (Task 1068).

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

  a. Performing proper aircrew coordination.

  b. Perform proper hover techniques in snow conditions (Task 1038).

  c. Perform Go-Around (Task 1068).

Spatial Disorientation Scenario #4- Training

Decreasing Visibility

Simulator Initial Conditions:

The IO:

1. Selects ALASKA – JUNEAU
2. Sets Scene Illumination – Noon
3. Sets Visibility at 1 statute miles
4. Sets Ceiling (Clouds) at 1000 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI, and I (the trainer) will play the role of the PC. Our mission is to transport engineers with the Corp of Engineers from the airfield to a Communication Relay Station located on a small island to the west. The LZ is equipped with an "Inverted Y" which is oriented 050 degrees. This mission has required several lifts with two remaining. You (the participant) are replacing the PI that flew the first two lifts with me earlier in the day. I am very familiar with the route. The current weather is 1000 overcast with 1 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 the LZ, located at N 58 23.55, W 134 46.37 . Terrain flight altitudes will be maintained throughout the mission. Upon arrival at the LZ, you will execute a VMC approach to the "Inverted Y", drop off passengers and return to the airfield." Perform a before takeoff check.

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

IO NOTE: Shortly after crossing the coast line, the IO to incrementally reduces visibility to 0.7 SM.

TRAINER NOTE: As the weather deteriorates continue to push towards the LZ. Mention desire to accomplish the mission and confidence in yourself and knowledge of the route. At approximately 5-7 km from the LZ, take the flight controls from the participant.

IO NOTE: At approximately 3 kilometers prior to reaching LZ, reduce the visibility to 0.5SM. At 1 kilometer prior to reaching LZ, reduce the visibility to 0.0 SM.

TRAINER NOTE: Upon losing visibility (IMC), do not perform IIMC procedures and thus, do not start a climb. Acting disoriented, the trainer will state, "I am all jacked up… You have the flight controls!"

Debriefing:

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

2. "While on a VFR mission, 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 that day. 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."

3. Ask the participant:

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

b. "What factors increased the likelihood of spatial disorientation in this situation?" (The following list is not all inclusive.)

(1) Procedures not per published guidance. (AR 95-1 requires pilots to maintain VFR flight rules while operating on a VFR flight plan. Once out of Class D airspace, the there was no way to maintain VFR (Day) with less than ½ SM visibility.)

(2) Lack of visual cues. (Fog / Overwater)

(3) Overconfidence.

(4) Procedures not per published guidance. (Improper IIMC)

(5) Poor mission planning.

(6) Failure to commit to IMC.

(7) Desire to accomplish the mission.

c. “How could this accident have been prevented?”

(1) Perform tasks and maneuvers per the ATM

(2) Follow published requirements and directives.

(3) Maintain situational awareness

d. “How could this situation be overcome once you are in it?”

(1) Performing proper IIMC procedures (Task 1184) per the ATM.

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

a. Updating weather brief.

b. Landing or RTB when VFR cannot be maintained.

c. Performing proper IIMC procedures.

Spatial Disorientation Scenario #1- Evaluation

Undetected Drift/Descent – Overwater

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - HOONAH
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 1 statute mile
4. Sets RANDOM VISIBILITY
5. Sets Ceiling (Clouds) at 1000 feet overcast
6. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) 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 that's not really how we fly in this unit, and I don't think it's necessary. 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 024 degrees. I'll show you an island which is located about 13 kilometers northeast of here (N 58:10.73 / W 135:15.47) 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."

IO NOTE: Once over the water, add precipitation and begin to decrease the visibility incrementally to .25 SM.

TRAINER NOTE: 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, $#*+!, WHATS MY ALTITUDE??... I NEED HELP!" The training flight concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #2- Evaluation

Inadvertent IMC

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - JUNEAU
2. Sets Scene Illumination – NOON
3. Sets Visibility at 1 statute mile
4. Sets Ceiling (Clouds) at 1000 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to transport troops from the airfield to an LZ located at (8V NK 3569 6094). 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; maintaining runway heading to pick up the southeastern river valley. Then we will proceed directly to the airstrip and insert the troops." Perform a before takeoff check.

TRAINER NOTE: Shortly after the aircraft takes-off, simulate a call from flight operations similar to the following: "Blackhawk 123, Phoenix X-Ray, be advised – there is a report of a possible aircraft mishap in vicinity of your destination LZ. Please move to that location, report findings and serve as on-scene commander as necessary."

IO NOTE: At approximately 2 minutes after takeoff, the IO will enable PRECIPITATION and begin to incrementally reduce the visibility to 0.5 SM. At approximately 2 km to LZ, reduce the visibility to 0.0 SM.

TRAINER NOTE: 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, can you take the controls?" The training concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #3- Evaluation

Undetected Drift/Descent

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - IC8
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 2 statute miles
4. Sets Ceiling (Clouds) at 1000 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) 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 approximately 10 kilometers away at GRID 8V ML 91010 13476 . 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 300 and fly at contour flight altitudes (25 to 80 feet) over the water." Perform a before takeoff check.

IO NOTE: After 2 minutes begin incrementally decreasing the visibility down to 0.9 SM.

TRAINER NOTE: After the visibility is reduced, the trainer slows the aircraft to 70 KIAS and continues flying. After a couple of kilometers, direct the participant to tune the radio to the ship frequency (FM 32.150). Then, the trainer will begin a slow descent into the water while the participant is still focused inside. The training flight concludes when the participant recovers or crashes the simulator.

Spatial Disorientation Scenario #4- Evaluation

Decreasing Visibility

Simulator Initial Conditions:

The IO:

1. Selects ALASKA - JUNEAU
2. Sets Scene Illumination – (10 JAN – 0800)
3. Sets Visibility at 2 statute miles
4. Sets Ceiling (Clouds) at 1200 feet overcast
5. Winds Calm

Scenario Development:

TRAINER READS TO PARTICIPANT: Pre-mission Briefing – "You (the participant) are assigned the role of PI and I (the trainer) will play the role of the PC. Our mission is to conduct a critical resupply of ammo and water to OP SPEAR (8V NK 35687 60942). They've been taken fire all day, and we have got to get these supplies to them or they are as good as gone. The weather is 1200 overcast with 2 SM visibility. Winds are calm. I will fly the aircraft and after takeoff from the airfield, I will proceed on course and fly at 1000' AGL and 120 knots to the OP" Perform a before takeoff check.

IO NOTE: After approximately 2 minutes after departure, reduce the visibility to 1 SM and ceiling to 1000' OVC. Do not lower the ceiling to the point that the A/C goes IIMC.

TRAINER NOTE: After the visibility is reduced, the trainer will descend and slow down as necessary to continue the flight to the OP. If the participant mentions the weather decreasing, continue to push the need to complete the mission.

IO NOTE: After two more minutes, reduce the visibility to 0.7 SM.

TRAINER NOTE: At this point, make the decision to return to base due to weather. However, do not commit to IFR; attempt to reverse course and maintain VFR enroute to home station.

IO NOTE: After approximately 1 minute, reduce visibility to 0.3 SM.

TRAINER NOTE: Begin a slow increase in pitch until zero airspeed is reached. Continue to pitch up until aircraft begins to descend backward at a high rate of speed. The trainer will repeat, "I've got it… I've got it…" until the participant takes the controls, or the aircraft impacts the ground. The training flight concludes when the participant recovers or crashes the simulator.

Department of the Army
U.S. Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-0577
www.usaarl.army.mil

U.S. Army Medical Research and Materiel Command