PROGRAMED TEXT

AVIATION PHYSIOLOGY
(VERTIGO AND ILLUSIONS)

AM-77

January 1969

UNITED STATES ARMY

PRIMARY HELICOPTER SCHOOL

FORT WOLTERS, TEXAS

PROGRAMED TEXT

PROGRAM TEXT

FILE NO: AM-77

PROGRAM TITLE
Aviation Physiology
(Vertigo & Illusions)

POI SCOPE: Student will learn conditions that cause unusual physiological effects and how he can minimize or correct for these effects.

INSTRUCTOR REFERENCES:

DA Pamphlet 95-3, Human Factors
DA Pamphlet 95-7, Flight Surgeon
Human Factors in Air Transportation by McFarland

PREPARED BY: TFPL

DATE: September 1967

REVISED BY: Maj Burdick

DATE: December 1968

APPROVED BY: Frederick B Weller **DATE:** 12 Jan 69

FREDERICK B. WELLER, LTC
Dir, TP&A Div

TABLE OF CONTENTS

PROGRAMED TEXT
FILE NO: AM-77

PROGRAM TITLE:
Aviation Physiology (Vertigo & Illusions)

PREFACE

Since man spends most of his time on the ground, his sensations are normally interpreted as if he were on the ground. During flight some sensations are falsely interpreted. This situation results in false illusions, vertigo and object fascination. As an aviator, you must learn the conditions under which unusual physiological conditions will occur and the actions to take in correcting for this unusual situation.

It is very important that you read each frame carefully and write down your answer before continuing to the next frame. If your response is incorrect, turn back and review the item missed to insure that you know the correct answer. If you are unable to solve a problem, raise your hand for assistance.

PERFORMANCE OBJECTIVES

Upon completion of this program text you will be able to identify:

1. The effects of temperature upon the aviator and how to minimize it.

2. The method for obtaining maximum visibility under low levels of illumination.

3. Vertigo, illusions and examples of each that can be encountered in flight.

4. The methods for preventing or minimizing the occurence of a false illusion.

5. Two symptoms and causes of flicker vertigo.

6. Two methods to minimize the danger of fascination.

7. Causes and effective methods for minimizing airsickness.

FRAME 1

Man maintains his equilibrium in flight through proper use of three sense organs: eyes, inner ear (three fluid-containing, semi-circular canals) and the abdominal organs, muscles, joints, tendons and skin. The eyes are the most important in orienting man with respect to other objects.

In the three situations below determine the sense organ used:

1. Eyes
2. Inner ear
3. Muscle, joints, skin, etc.

a. 2 In a slow turn to the right he senses the turn but does not feel it.

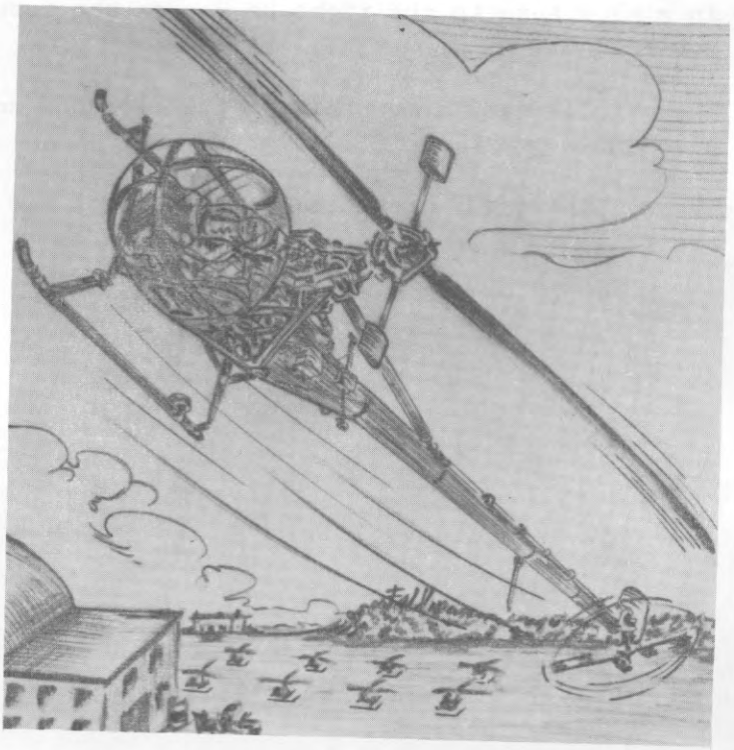
b. 1 The aviator sees a mountain in the distance and uses it as a check point.

c. 3 The aviator feels pressure on the seat of his pants.

ANSWER: b. /X/ is banking

FRAME 12

Illusion of climbing and descending: In the absence of visual reference, the only sensation imparted in a properly executed turn is awareness of the body being pressed more firmly into the seat. Normally, this sensation is associated with climbing, and may be falsely interpreted as such. Following the increased pressure of the body on the seat brought about by the centrifugal force of turning, recovery from turning lightens the pressure. As a consequence, an illusion of descending is produced.



Awareness of the body being pressed more firmly into the seat is falsely interpreted as:

a. /___/ descending.

b. /___/ turning left.

c. /~~/ climbing.

d. /___/ all of the above.

ANSWER: 2, 1, 3, Inner ear, eyes and muscle, joints, skin, etc

FRAME 2

During acceleration in flight you feel as though you are climbing, and in deceleration you feel as though you are descending. The maintenance of aerial equilibrium is dependent on the attitude of the helicopter, not the feel of the body organs or the body position of the aviator.

An aviator who has the feeling he is climbing should:

a. /___/ Make corrections to fly on the level.

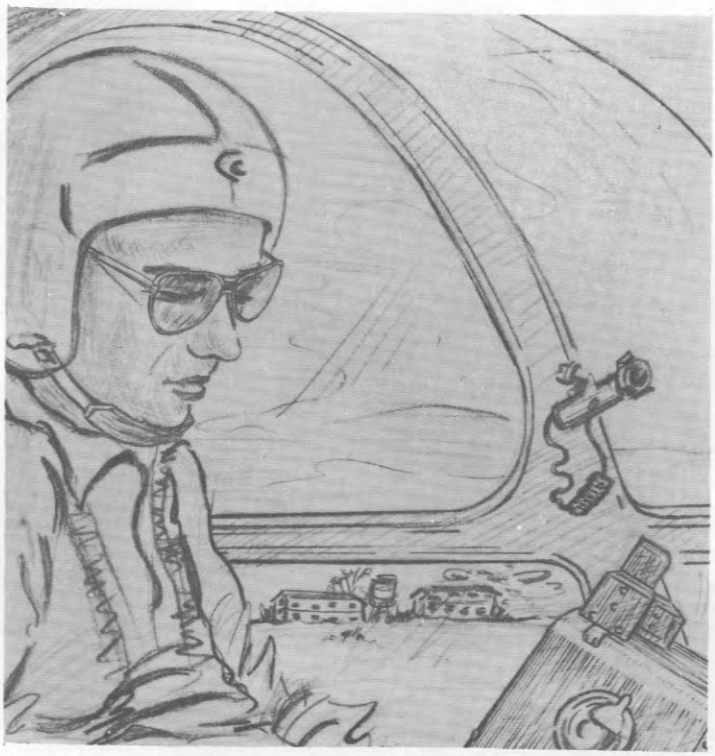
b. /✓/ Check instruments prior to making any corrections.

c. /___/ None of the above.

ANSWER: c. /X/ Climbing

FRAME 13

Fascination: Fascination is a strong mental state that can be extremely hazardous to aviators. It is a state of narrowed attention associated with excessive concentration on one portion of the task, to the exclusion of the rest of one's environment. In this strange state, the pilot can get so involved in one instrument, for example, that he can not see, hear nor think of anything else. In helicopter students, the instrument that heads the list is the RPM indicator.



A young army aviator kept watching his RPM indicator and each time he was observing the instrument for a longer period of time:

Fascination is caused by:

a. /___/ scanning the horizon .

b. /___/ listening to radio .

c. /✓/ excessive concentration .

d. /___/ all of the above .

ANSWER: b. /X/ Check instruments prior to making corrections.

FRAME 3

Undetected Motion: A group of illusions arises from the incapacity of the semi-circular canals to detect slight accelerations; undetected motion applies particularly to blind flying without proper instrument orientation. As a consequence of the inability of the semi-circular canals to detect these changes in motion, a relatively high rate of turning, climbing, diving or banking may be built up gradually without being detected.

A helicopter aviator was making a night flight without proper instrument orientation and he becomes disorientated and crashes into a mountain some twenty miles off course. The accident was caused by the aviator:

a. /✓/ Not instrument orientated.

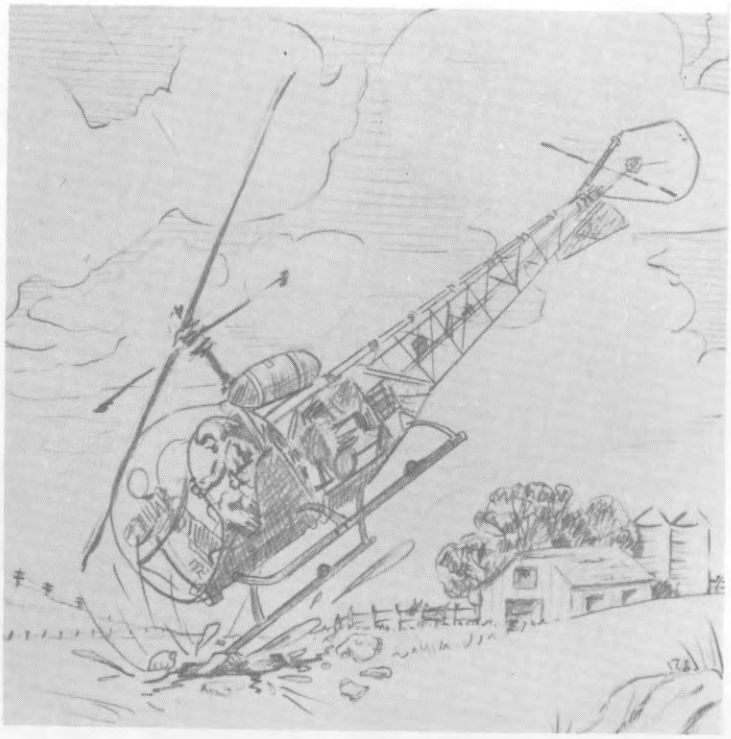
b. /___/ Not reading map properly.

c. /___/ Flying too low.

ANSWER: c. /X/ Excessive concentration

FRAME 14

Fascination: Another type of fascination is target fixation. This is seen in the low level rocket run when the pilot is concentrating so hard on hitting the target that he fails to notice loss of altitude and flies into the ground. It also occurs in excessive concentration on the lead plane in formation. Fascination is the result of excessive concentration on one object.



Fascination can be extremely dangerous and all aviators should be aware that:

a. /___/ Scanning the horizon will cause fascination.

b. /✓/ Excessive concentration on one object will cause fascination.

ANSWER: a. /_X_/ Not instrument orientated

FRAME 4

There is an extremely powerful illusion caused by moving the head in one direction while the aircraft is rotating in another direction. The vertigo resulting may be incapacitating and even cause sudden nausea and vomiting. The reason for this illusion is that a second semi-circular canal in the inner ear has been shifted into the plane of rotation and stimuli from both are fed into the brain, causing Illusions.

A helicopter aviator in Vietnam had just taken off with supplies attached in a sling. He had been looking over the right side of his helicopter while supplies were being attached. As the helicopter was moving foward he suddenly raised his head and looked foward and had a sensation he was banking to the left.

The aviator should do one of the following:

a. /___/ Over compensate by banking to the left.

b. /_✓_/ Do nothing.

c. /___/ Turn helicopter to the right sharply.

ANSWER: b. /X/ Excessive concentration on one object, will cause fascination.

FRAME 15

Symptoms of airsickness: The first symptoms of airsickness are almost always encountered in the gastro-intestinal tract. This is the most primitive of the bodily systems and as such generally reacts first to a functional nervous disturbance. This is followed by cold and clammy skin, a feeling of nervousness and muscular tenseness and generalized muscular weakness.

An aviator flying in bad weather became sick and was forced to land. The sickness was first noticed by:

a. /___/ Feeling cold and clammy.

b. /___/ Muscular tenseness.

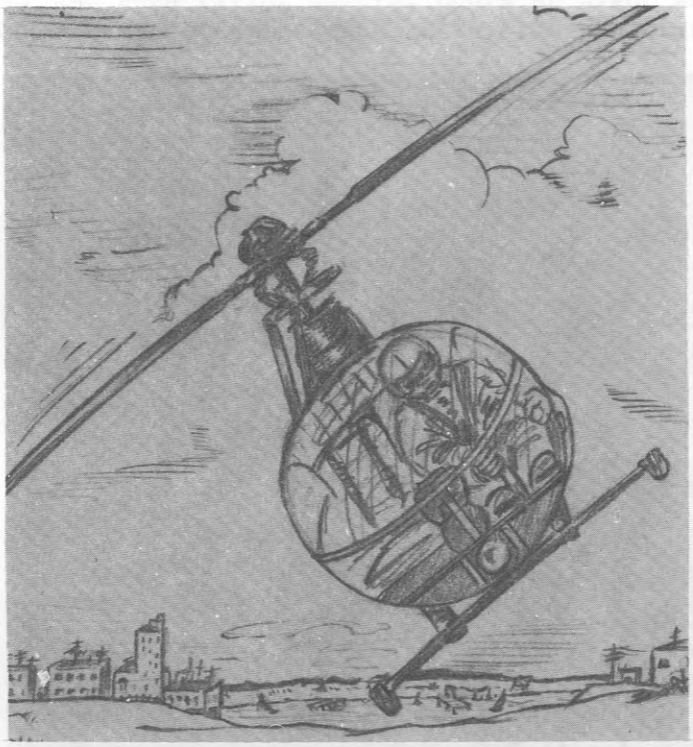
c. /✓/ Sickness in the gastro-intestinal tract.

d. /___/ All of the above.

ANSWER: b. /X/ Do nothing

FRAME 5

Illusion of turning: A gradual turn may be undetected. If suddenly corrected, it may give the impression of turning in the opposite direction, for the fluid in the involved semi-circular canals continues to move in the direction of the correction. Historically, study of this specific illusion demonstrated the need for the development of instrument flying.



A helicopter in a gradual turn is suddenly corrected by the pilot. You will get the impression it is turning in the:

a. /✓/ Opposite direction.

b. /___/ Same direction.

ANSWER: c. /_X_/ Sickness in the gastro-intestinal tract

FRAME 16

Airsickness causes are numerous and range from actual fear of flying to the more subtle fears that are deep in the subconscious mind of the student. Other causes of airsickness is the organ of equilibrium located in the inner ear and turbulent air. Once airsickness has occurred in flight, the most effective treatment is return to the ground. The use of drugs, if prescribed by flight surgeon; improved aircraft ventilation, and the use of 100% oxygen if available, are helpful.

An aviator became very sick while in flight: Which of the following actions should he have taken first:

a. /✓/ Ventilate the helicopter .

b. /___/ Use drugs prescribed by flight surgeon .

c. /___/ Use 100% oxygen if available .

ANSWER: a. /_X_/ Opposite direction

FRAME 6

Optical Illusions: A familiar example of this is the illusion of motion while seated in a railway train at rest and observing an adjacent train in motion. Illusions of vision may occur by day or by night. The most common one that occurs to aviators during the daylight is a feeling of tilting when flying between two cloud banks of different slope, the two banks sloping toward each other and at the same time obliterating the horizon from view. Optical Illusion may occur by day or by night.

A pilot flying between two cloud banks of different slopes will feel:

a. /✓/ As though the plane is banking.

b. /___/ As though the plane is turning.

ANSWER: a. / X / Ventilate the helicopter

FRAME 17

A tremendous range (-50° to 130°F) of temperatures are encountered by Army Aviators. The hottest temperatures occur from the greenhouse effect of canopies, or bubbles,and the coldest occur in the polar regions. Acclimation is the process of the body adaptating to the stress of environmental temperatures.

Helicopter pilots will encounter extreme temperatures from time to time. The pilot should remember that the best way to improve performance in extreme temperatures is through:

a. /___/ Taking drugs.

b. /___/ Sleeping 16 hours per night.

c. /___/ Eating a lot of food.

d. /✓/ Giving the body time to adapt to climate.

ANSWER: a. / x / As though the plane is banking

FRAME 7

Flicker vertigo is a vertigo produced by steadily flashing lights, such as sunlight passing through rotating helicopter blades or through the propeller of a fixed wing plane flying into the sun. It can also be caused by reflecting of blinking anticollision and navigational lights off fog or haze. Lights flickering continuously will cause Flicker Vertigo.

"An army aviator was flying west on a clear day when suddenly a light started flashing in his eyes"

The Flicker vertigo was caused by:

a. /___/ Flashing lights.

b. /___/ Sun passing through rotating helicopter blades.

c. /___/ Blinking anticollision lights.

d. /___/ All the above.

ANSWER: d. / X / Giving the body time to adapt to climate

FRAME 18

Acclimation to a cold climate requires caution and common sense. Higher protein diets should prevail in the cold climates in order to elevate the metabolism. Clothing is of the greatest importance in reduction of stress of environmental temperature.

Effects of cold climates can be minimized by:

a. /___/ Eating higher protein diet .

b. /___/ Wearing proper clothing .

c. /✓/ Both of the above .

ANSWER: b. /X/ Sun passing through helicopter blades

FRAME 8

Flicker Vertigo may cause convulsions in some unusually sensitive individuals; in others it causes annoyances such as increased tension, anger, apprehension and headaches. Most aviators can overcome the effect of Flicker Vertigo by ignoring it and concentrating on the task at hand. Maintaining a normal scanning vision is helpful. In an overcast, particularly during let downs and approaches, pilots should switch the rotating beacon off.

An aviator had been flying several hours at night and had developed a severe headache. He determined he had Vertigo and that it was caused by:

a. /___/ Landing lights.

b. /✓/ Rotating beacon on helicopter.

c. /___/ Observing lights on the ground.

ANSWER: c. / X / Both of the above

FRAME 19

"Heat Exhaustion" occurs when the heat-dissipating mechanism fails. Contributary causes in healthy individuals include excess loss of fluid, resulting in salt depletion. Major changes occur in acclimatization to heat within a week and are chiefly in the heart and blood vessels. Apathy, lack of desire to exert oneself and reduced appetite occur with initial exposure.

An aviator inspected his helicopter when the temperature was 110°F After the inspection, he got into the helicopter where the temperature was 135°F. This type situation can result in:

a. /___/ Depletion of salt in the body.

b. /___/ Heat exhaustion.

c. /___/ Excess loss of fluids.

d. /√/ All of the above.

ANSWER: b. / X / Rotating Beacon on helicopter.

FRAME 9

A sensation or illusion occurs when an individual stares at one light for a long period of time. Eventually the light will appear to move up or down, although actually it has not.

This illusion may be avoided by not staring continuously at any light during night flying. Added precaution should be taken by moving eyes from light to light every 5 - 8 seconds.

A helicopter pilot flying night formation suddenly realized the light on the lead helicopter was moving up and down as well as to both sides. He immediately took corrective action by looking at the panel lights and then at the lead plane light, and continued to move eyes from one light to another during the flight.

Did the pilot take the corrective action?

a. /√/ Yes.

b. /___/ No.

ANSWER: d. /X/ All of the above

FRAME 20

Night adaptation: After thirty minutes in darkness there is little increase in the sensitivity of the eyes. Exposure to bright lights can destroy the dark adaptation in 30 seconds. While flying, the head should be turned or one eye should be shielded from flares, explosions and bright lights to prevent temporary blindness from losing night vision.

Aviators planning to fly at night should adjust their eyes to the darkness. This requires:

a. /___/ 1 hour .

b. /___/ 5 minutes .

c. /✓/ 30 minutes .

d. /___/ 30 seconds .

ANSWER: a. / X / Yes

FRAME 10

Stars and Illusions: A small cluster of stars may be mistaken for the lights of a formation and the pilot makes a futile effort to join up with them. A small cluster of lights on the ground on a dark night may also look like a formation, and the pilot attempting to join them flies into the ground. Cross-checking instruments and positive reference points will prevent such illusions.

An aviator flying last in formation ("Tail End Charlie") was observing stars off to his right when he had the sensation that these stars were his formation.

Illusions caused by stars and clusters of lights on the ground can be prevented by:

a. / √ / Cross checking instruments.

b. / √ / Positive reference points.

c. / √ / Both of the above.

ANSWER: c. /X/ 30 Minutes

FRAME 21

One excellent way of scanning an area for aircraft is to relax your eyes and focus on a distant object. Any object moving in the area will catch your attention and you can then focus on it.

The best way to detect aircraft in your area is to:

a. /___/ Look straight ahead .

b. /___/ Use radio .

c. /___/ Concentrate on RPM Gage .

d. /✓/ Relax your eyes and focus on a distant object..

ANSWER: c. /X/ Both of the above

FRAME 11

Illusion of Banking (the leans): An illusion arising from another fallibility of the inner ear is a sensation of banking felt by the pilot when his instruments indicate he is flying on the level. This arises from the inability to detect gradual motions. Although he maintains the ship in level flight in conformity to the instruments, the sensation is that the plane and himself are banking to the side.

The fallibility of the vestibular apparatus to detect gradual motions results in sensations that the helicopter:

a. /___/ is stalling out.

b. /✓/ is banking.

TURN TO PAGE 2 FOR FRAME 12

ANSWER: d. /X/ Relax your eyes and focus on a distant object.

FRAME 22

Smoking has a very adverse effect on night vision. This is due to carbon monoxide. The carbon monoxide obtained from cigarettes is such that if only 3 are smoked consecutively, night vision will be reduced up to 35%. The rule is not smoking for at least one hour prior to night flight and never during the flight.

Smoking has an adverse effect on aviators, especially their night vision. Cigarettes should not be smoked:

a. /___/ 60 minutes before flight.

b. /___/ during flight.

c. /✓/ both of the above.

INTENTIONALLY

LEFT BLANK

ANSWER TO FRAME 22: c. / X / Both the above

SELF EVALUATION EXERCISE
FOR
VERTIGO, ILLUSIONS, FASCINATION & CLIMATIC CONDITIONS

1. An aviator uses three sense organs to maintain his equilibrium in flight.

   An aviator flying low level will use the following sense organs:

   a. /___/ Eyes

   b. /___/ Seat of his pants

   c. /___/ Smell & inner ear

   d. /✓/ All of the above

2. Acceleration and deceleration in flight:

   An aviator that feels as though he is descending should do the following:

   a. /___/ Speed up the RPM

   b. /✓/ Check his instruments

   c. /___/ Make corrections to fly on the level

   d. /___/ None of the above

3. Undetected motion:

   An aviator crashed into a radio tower on a rainy night. This accident was caused by:

   a. /___/ not using instruments properly

   b. /___/ being unable to detect gradual turns

   c. /___/ unable to see lights on tower

4. A powerful illusion is caused by moving the head in one direction while the aircraft is rotating in another direction.

   A helicopter pilot had been flying low and looking out the right side of the helicopter intently at the ground. He abruptly brought his head up and looked straight ahead. What sensation did he get?

   a. /✓/ Banking to the left

   b. /___/ Banking to the right

   c. /___/ Climbing

5. Gradual turns are not detected in many instances by aviators. Instruments were developed to minimize this danger.

A helicopter pilot located his position and found he was some ten miles off course. He turned his helicopter sharply to the left. He got the sensation of turning in the:

a. /✓/ Opposite direction of the gradual Turn

b. /___/ Same direction

6. Optical illusions are encountered by all pilots at one time or another.

An aviator had been flying formation for several hours. When he looked at the helicopter on his left he sensed that the helicopter was moving away from him. The aviator should take the following action:

a. /___/ Increase his speed

b. /✓/ Check his position with lead helicopter

c. /___/ Locate a check point

7. Flicker Vertigo is a very strong illusion.

An aviator had been flying a westerly course in fair weather and suddenly he developed a severe headache. This Vertigo was caused by:

a. /___/ Excessive heat

b. /✓/ Sun shining through helicopter blades

c. /___/ Bright sun light

8. A sensation or illusion occurs when an individual stares at one light for a long period of time.

A pilot was night flying in formation and was using the light on the wing tip as a guide. Suddenly the light started moving up, down, and to both sides. What action should the pilot take?

a. /___/ Check his instruments

b. /___/ Locate a check point

c. /✓/ Look at no light for more than 5-8 seconds at a time

9. Stars and cluster of lights:

An aviator flying formation with two other helicopters kept observing lights on the ground and suddenly he felt the sensation that these lights was his formation. The aviator should:

a. /___/ Locate Check Point

b. /___/ Check instruments

c. /✓/ Both of the above

10. Illusion of Banking (the leans):

An aviator had the sensation his helicopter was banking to the point that he was leaning to the right in an effort to keep his body up right. The aviator should take the following action:

a. /✓/ Check instruments

b. /___/ Verify position with check point

c. /___/ Both of the above

11. Illusion of climbing and descending:

Awareness of the aviators body being pressed more firmly into the seat is falsely interpreted as:

a. /✓/ Climbing

b. /___/ Turning left

c. /___/ Turning right

d. /___/ Descending

12. Fascination is a strong mental state that can be extremely hazardous to the aviators.

An army aviator continued to watch his altimeter and crashed into a radio tower. This accident was caused by:

a. /___/ Looking out of the helicopter

b. /___/ Scanning for other aircraft

c. /✓/ Watching altimeter indicator intently

d. /___/ All of the above

13. Another type fascination is target fixation.

An army aviator was making runs over a target and he almost crashed. This was caused by:

a. /___/ Flying too low

b. /✓/ Over concentration

c. /___/ Instruments not operating properly

14. Symptoms of air sickness:

An aviator was flying in very rough weather when he became very sick. The sickness was first indicated by:

a. /___/ Headache

b. /___/ Muscular tenseness

c. /✓/ Sickness in the gastro-intestinal track

15. Treatment of air sickness:

An aviator became very sick during a flight through thunder storms. What action should the aviator have taken?

a. /✓/ Ventilate helicopter

b. /___/ Fly at lower altitude

c. /___/ Take drugs

16. Aviators operate in temperature ranges of -50°F to 130°F.

An aviator will encounter extreme temperatures from time to time. In extreme temperatures an aviator should:

a. /___/ Take shots

b. /___/ Drink a lot of water

c. /___/ Work only at night

d. /✓/ Take it easy and give the body time to adjust to the climate.

17. Acclimatization to cold climate:

An aviator was transferred to Alaska where the temperature was -33°F. What actions should the aviator take to help him adjust to the cold climate.

a. /___/ Stay in a warm building

b. /___/ Take drugs

c. /X/ Wear warm clothes

d. /X/ Eat a high protein diet.

18. Heat Exhaustion:

An aviator was transferred to a base in the desert country of the South West. He was inspecting his helicopter in temperature of 112°F. This could result in:

a. /___/ Heat exhaustion

b. /___/ A feeling of going blind

c. /___/ Excess loss of body fluids

d. /X/ Two of the above

19. Night adaptation:

An aviator had spent 30 minutes in a dark room adaptating to the dark. If he stepped into a lighted room how long would his night adaptation last.

a. /___/ 10 minutes

b. /___/ 1 hour

c. /X/ 2 - 30 seconds

20. Smoking has an adverse effect on aviators night vision:

An aviator was smoking one cigarette after another while waiting for a night mission. This could result in:

a. /___/ Losing night vision

b. /X/ Losing 35% of night vision

c. /___/ No effect at all

Key to Self Evaluation Exercise
For
Vertigo, Illusions, Fascination and Climatic Conditions

1. d
2. b
3. a
4. a
5. a
6. b
7. b
8. c
9. c
10. a
11. a
12. c
13. b
14. c
15. a
16. d
17. + c + d
18. d
19. c
20. b

L2147 Army-Ft. Sill, Okla.