

Aircraft Safety

Accident Investigations, Analyses, and Applications

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Second Edition

McGraw-Hill

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0-07-143393-7

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DOI: 10.1036/0071433937



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Contents

Introduction xi

PART I HUMAN FACTORS I

I Judgment and Decision-Making 3

Principles of Good Judgment and Decision-Making 3
Good Judgment and Decision-Making in Practice 4
Influences That Affect Judgment 7
Hazardous Thought Patterns Exercise 10
References 28

2 Accurate Situation Assessment Leads to Good Situation Awareness 29

Phase 1: Recognition 30
Phase 2: Evaluation 30
Situation Awareness through Monitoring and Challenging 31
Airborne Express DC-8—Breakdown in Situation
Awareness 34
References 36

3 Crew Resource Management: The Integration of Interpersonal Skills and Technical Proficiency 37

Interpersonal Communication 38
Crew Effectiveness 38
Reference 40

4 Spatial Disorientation 41

Senses and Spatial Orientation 42
Visual and Vestibular Senses 43
Sensory Illusions 45
Types of Spatial Disorientation 53

Prevention 54
References 55

Part I Case Studies 57

Case Study I-1: American Airlines Flight 1420 57
Case Study I-2: TWA Flight 843 62
Case Study I-3: Korean Air Flight 801 69
Case Study I-4: Northwest AirlinK Flight 5719 83
Case Study I-5: Avianca Flight 052 90
Case Study I-6: American Eagle Flight 3379 107
Case Study I-7: John F. Kennedy, Jr. 112
Case Study I-8: Delta Airlines Flight 106 122
International Case Study I-9: Singapore Airlines
Flight 006 125
Historical Case Study I-10: Eastern Airlines Flight 401 134

PART II RUNWAY INCURSIONS 141

Runway Incursion Severity Categories 145
Reported Runway Incursions by Severity 145
Distribution by Aircraft Type and Combination 145
Conclusions 145
References 146

Part II Case Studies 147

Case Study II-1: USAir Flight 1493 and Skywest
Flight 5569 147
Case Study II-2: TWA Flight 427 and a Cessna 441 157
Case Study II-3: United Express 5925 and a Beechcraft
King Air A90 166
Case Study II-4: Northwest Flights 1482 and 299 177
Case Study II-5: Eastern Flight 111 and a Beechcraft
King Air 100 187
Historical-International Case Study II-6: Pan American Flight
1736 and KLM Flight 4805 199

PART III WEATHER 211

5 Air Masses and Fronts 213

Air Masses 213
Fronts 214
Frontal Waves 216
Occlusions 217
References 218

6 Cloud Formation 219

- Low Clouds 219
- Middle Clouds 220
- High Clouds 221
- Extensive Vertical Development 222
- Special Cloud Types 222
- References 223

7 Thunderstorms 225

- Unstable Air 225
- Lifting Action 225
- Moisture 226
- Life Cycle of a Thunderstorm Cell 226
- Types of Thunderstorms 228
- Meteorological Observations 229
- Aircraft Performance in Heavy Rain 230
- References 232

8 Downbursts and Low-Level Windshear 233

- Macrobusts 233
- Microbursts 234
- Types of Microbursts 234
- Types of Parent Clouds 236
- Temperature Parameters 237
- Low-Level Windshear 238
- Indicators of Windshear 239
- References 240

9 Icing Conditions 241

- Stratiform Clouds 241
- Cumuliform Clouds 241
- Cirriform Clouds 242
- Structural Icing 242
- Ice Formation on Fixed-Wing Aircraft 247
- Frontal Zones 250
- Induction Icing 251
- References 253

10 Turbulence 255

- Convective Turbulence 255
- Mechanical Turbulence 256
- Mountain Range Turbulence 256
- Mountain Wave Turbulence 257
- Turbulence in Narrow Canyons and Gorges 258
- Flying Guidelines around a Mountain Wave 261

Clear-Air Turbulence 262
References 262

Wake-Vortex Turbulence 265

Wake-Vortex Motion 265
Atmospheric Factors 267
Flying Guidelines 268
Wake-Vortex Research 269
Boeing 757 Safety Concern 270
Wake-Vortex Accidents 270
References 276

Part III Case Studies 277

Case Study III-1: USAir Flight 1016 277
Case Study III-2: American Eagle Flight 4184 288
Case Study III-3: Delta Airlines Flight 191 295
Case Study III-4: USAir Flight 405 305
International Case Study III-5: China Airlines
Flight CI-012 314
Historical Case Study III-6: Southern Airways Flight 242 322

PART IV MID-AIR COLLISIONS 343

Reference 344

12 Mid-Air Collision Avoidance: From See-and-Avoid to Search-and-Detect 345

Eye-Brain Connection 347
Eye Movement 348
Distant Visual Acuity 349
Cockpit Creates Monocular Visual Areas 352
Effective Scanning Based on Sectors 353
Enhancing Visual Skills 354
References 356

Part IV Case Studies 359

Case Study IV-1: A Cessna 340 and a North
American T-6 359
Case Study IV-2: A Cessna Citation and a Cessna 172 365
Case Study IV-3: Aeromexico Flight 498 and a Piper
Cherokee 368
Case Study IV-4: A U.S. Army U-21 and a Piper Navajo 373

| | |
|--|-----|
| Case Study IV-5: A Mitsubishi MU-2 and a Piper Saratoga | 380 |
| Historical Case Study IV-6: PSA Flight 182 and a Cessna 172 | 389 |

PART V MECHANICAL AND MAINTENANCE 397

Part V Case Studies 399

| | |
|---|-----|
| Case Study V-1: TWA Flight 800 | 399 |
| Case Study V-2: United Flight 585, USAir Flight 427, Eastwind Flight 517—A Compilation of Uncommanded Rudder Events in B-737 Aircraft | 415 |
| Case Study V-3: ValuJet Flight 592 | 424 |
| Case Study V-4: Atlantic Southeast Airlines Flight 2311 | 436 |
| Case Study V-5: United Airlines Flight 232 | 445 |
| International Case Study V-6: Air France Flight 4590 | 456 |
| Historical Case Study V-7: American Airlines Flight 191 | 458 |

Index 465

moving at up to 20 degrees per second in one or many directions. When flying, a pilot could lose control of the airplane in attempting to align it with the false movements of the light. Military pilots have been known to attempt to rejoin in formation flying toward Venus or a star, and civilian pilots have done evasive maneuvers to avoid stars. The autokinetic effect helped convince them that stars were moving aircraft lights. Radars, radios, and collision avoidance systems help provide cues to avoid taking incorrect actions in flight due to the autokinetic effect.

BLACK HOLE

When in a situation without peripheral cues, such as landing on a very dark runway or in a snow or sand storm, pilots must rely on focal vision when a combination of focal and ambient vision would be preferable. In a black-hole situation over water, when there is no visible horizon or only the runway lights are visible, or a black-hole situation complicated by landing on a dark night with a distant town on a hill rising beyond a runway, a pilot may feel that the aircraft is stable but the runway is moving or is in an incorrect position. Landing short is the common fatal mistake from failing to recognize and correct the aircraft's position in time.

WHITEOUT APPROACHES

Like the black-hole approach, the whiteout approach causes disorientation and incorrect pilot responses due to the lack of peripheral or ambient cues. An atmospheric whiteout occurs when there is no visible horizon because the white snow-covered terrain blends in with the overcast or solid white sky. In this case, visibility might be "unrestricted," but visual cues are lacking. Similarly, blowing snow or sand may create a whiteout (or gray-out), but this is due to poor visibility causing lack of peripheral cues. Helicopters hovering low or attempting to land may cause a whiteout through rotor wash.

SIZE CONSISTENCE

Commonly a depth-perception issue, size consistence is particularly a factor in landing, when a pilot perceives her distance from a runway

based on the width and distance from a runway. For example, when accustomed to a certain size runway, a pilot approaching a narrow runway may perceive that the aircraft is higher than it actually is. This results in a low approach and a late flare, and usually a hard landing. Conversely, a wide runway can lead a pilot to perceive that he is too close to the runway, causing him to make a high approach and early flare, resulting in a dropped-in landing or excessive floating and a long landing (see Fig. 4-2).

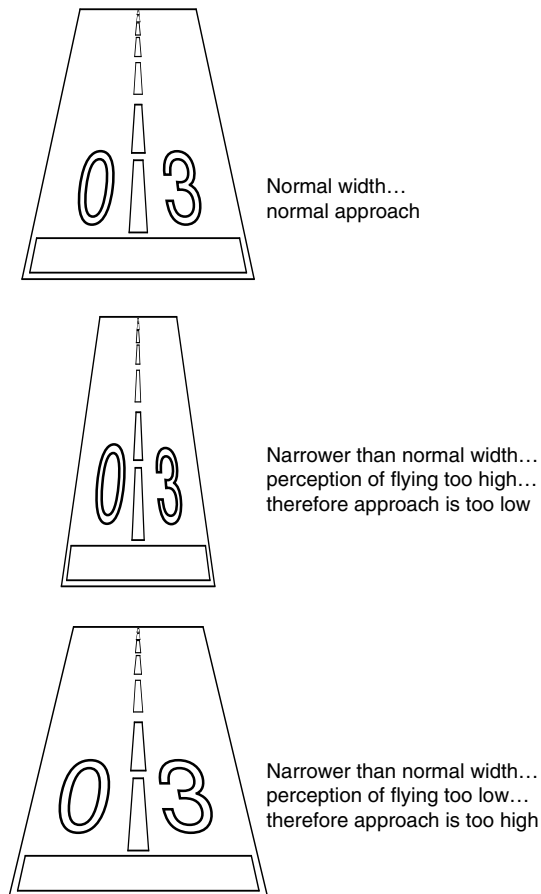
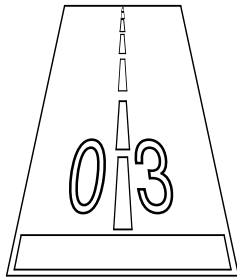


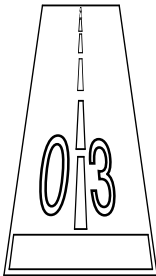
Fig. 4-2. Size consistence example.

SHAPE CONSISTENCE

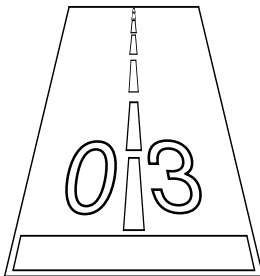
An example of this visual illusion is when a runway is not level and either slopes up or down from the approach end. When the runway slopes up from the approach end, the pilot perceives that the approach is too high and, therefore, flies too low of an approach. The opposite is true of a runway that slopes down from the approach end (see Fig. 4-3).



Flat runway...
normal approach



Runway slopes up...
perception of flying too high...
therefore approach is too low



Runway slopes down...
perception of flying too low...
therefore approach is too high

Fig. 4-3. Shape consistence example.

FALSE HORIZON

A sloping cloud deck, or the lights of a town lying on a slope viewed at night, can create the perception of appropriate visual cues resulting in inappropriate control inputs. When correcting the aircraft's flight to match the misperception of a false horizon, slow corrections may result in equilibrium in the vestibular system. This creates a sensation of straight-and-level flight that matches the visual perception, when the aircraft is actually in a bank. These illusions may create significant confusion when the brain is sure that a horizon is real but the flight instruments, in contrast, show a bank (see Fig. 4-4).

HEIGHT PERCEPTION ILLUSION

When flying over terrain with poor visual cues or references, such as the sea or a barren desert, or when flying over repetitive terrain such as a forest, in the dark, a pilot may perceive the attitude of the aircraft to be much higher than it actually is.



Fig. 4-4. False horizon—sloping cloud deck. Microsoft Clipart.

Somatosensory Illusions

GIANT HAND

In some spatial disorientation situations, the pilot may want to initiate a control input to correct her condition, but feels as if a hand is pushing against her in the opposite direction. This “giant hand” phenomenon is a subconscious result of cognitive dissonance; the mind and trained reflex pattern are fighting one another in an extremely disorientating situation.

Types of Spatial Disorientation

Spatial disorientation cases are frequently divided into three types based on the pilot’s awareness and reaction.

Type I

This is a condition where the pilot does not recognize the spatial disorientation. It is the most deadly type because, since the disorientation is unrecognized, the pilot takes incorrect actions or makes inappropriate control inputs. Flying in what appears to be a wings-level attitude above a gently sloping cloud deck but without noticing the frequent input of trim to maintain the apparent wings attitude is an example. Upon looking back inside the cockpit, the pilot may find that he had trimmed in 5 degrees of right turn to maintain wings-level with the cloud deck beneath the aircraft. This Type I spatial disorientation situation was caused by a false horizon.

Type II

In this case, a pilot recognizes that something is wrong but has not recognized that the problem is caused by spatial disorientation. For example, a pilot increases speed to one assigned by the controller to maintain good separation from another aircraft. After setting the new speed, the pilot then notices that he has descended several hundred feet and is still descending. He climbs and rechecks his instruments. The pilot may have experienced an oculo-gravic illusion.