General Aviation Accident Analysis

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President
Greater Houston Association of Flight Instructors

Presented at the
Flight Instructor Recertification Clinic
January, 2000
Based on:

Air Safety Foundation
AOPA
Frederick, Md

Accident Facts
National Safety Council
Itasca, Il

Traffic Safety Facts
US Department of Transportation
National Highway Safety Administration
National Center for Statistics and Analysis
Washington, D.C.
**General Aviation Basic Dimensions**

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Airplanes</td>
<td>160,000 airplanes</td>
</tr>
<tr>
<td>Flight Hours</td>
<td>20,000,000</td>
</tr>
<tr>
<td>Total Accidents</td>
<td>1853</td>
</tr>
<tr>
<td>Fatal Accidents</td>
<td>383</td>
</tr>
<tr>
<td>Fatalities</td>
<td>679</td>
</tr>
</tbody>
</table>

**1985-1995 Accident Rate**

8-10 / 100,000 hours
**1985 - 1995 Accident Rate**

8-10 per 100,000 flight hours

- “Accident rate has remained relatively steady over the last six years.”
- “Fatal accidents rate remains relatively constant of the past 16-17 years.”
- “… due to the same causes occurring at the same rates as over the past several years.”

-- 1998 Nall Report, AOPA ASF
Accident Causes: ASF Categories

- Mechanical and Maintenance
- Mid-Air, Drugs, Medical, Ground
- Pilot-Related
- Unknown
Proportion of Accidents by Major Cause

- Pilot-related: 80%
- Mechanical and Maintenance: 16%
- Other: 2%
- Unknown: 2%
Mechanical / Maintenance Cause Breakdown

- Engine / Prop: 70%
- Gear / Brakes: 15%
- Oil System: 5%
- Controls/Airframe: 2%
- Fuel System: 3%
- Electrical / Ignition: 3%
- Vacuum Sys / Instruments: 2%
MDMG Causes

Midair Collisions (15)
  8 fatal collisions, 24 fatalities
  5 collisions during flight instruction
  8 collisions during personal flying

Alcohol and Drugs (2)

Medical and Pilot Incapacitation (0)

Ground Injuries
  7 off-airport fatalities
  5 prop strike fatalities
Pilot-Related Causes

- Preflight/Taxi
- Takeoff/Climb
- Weather
- Fuel Management
- Other Cruise
- Approach
- Go-around
- Maneuvering
- Landing
- Other
“Maneuvering” Subcategory

Low and Slow Flight
   Aerial application
   Banner towing
   Law enforcement
   Personal (56% of the fatal accidents in this sub-category)

Collision with terrain, wires, towers (not on approach)

Structural failure during unauthorized aerobatics
“Landing” Subcategory

Loss of control
Accidents due to “loss of control while landing in crosswinds or gusts”
SEFG: 40% of landing accidents
SERG: 17% of landing accidents

Hard Landings

Landed long and/or fast

Gear up
Major Pilot-Related Causes: SEFG

Non-Fatal
  Landing (286)

Fatal
  Maneuvering flight
  Weather
Major Pilot-Related Causes: SERG

Non-Fatal
   Landing (57)

Fatal
   Weather
   Takeoff/Climb
   Maneuvering flight
   Approach
Major Pilot-Related Causes: **ME**

- **Non-Fatal**
  - Landings (36)

- **Fatal**
  - Weather
  - Takeoff/Climb
  - Approach
Of All Accident Causes

80%

Pilot-Related Causes
Compared to Our Favorite Fears

5 Times

more likely than mechanical/maintenance failure
Compared to Our Favorite Fears

5 Times
more likely than mechanical/maintenance failure

100 Times
More likely than a mid-air collision
Compared to Our Favorite Fears

5 Times
more likely than mechanical/maintenance failure

100 Times
More likely than a mid-air collision

200 Times
More likely than a mid-air collision during personal flying
Compared to Our Favorite Fears

5 Times
more likely than mechanical/maintenance failure

100 Times
More likely than a mid-air collision

200 Times
More likely than a mid-air collision during personal flying

300 Times
More likely than a mid-air collision during flight instruction
A Closer Look at Pilot-Related Causes
### The Major Pilot-Related Accident Causes

<table>
<thead>
<tr>
<th>Category</th>
<th>SEFG</th>
<th>SERG</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take-off/ Climb</td>
<td>23.5%</td>
<td>19.9%</td>
<td>20.5%</td>
</tr>
<tr>
<td>Maneuvering</td>
<td>13.5</td>
<td>6.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Landing</td>
<td>31.7</td>
<td>31.5</td>
<td>30.8</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>68.7</td>
<td>58.0</td>
<td>52.3</td>
</tr>
<tr>
<td>Weather</td>
<td>6.2</td>
<td>16.0</td>
<td>18.8</td>
</tr>
<tr>
<td>Fuel Mgmt</td>
<td>8.0</td>
<td>9.4</td>
<td>8.5</td>
</tr>
<tr>
<td>Approaches</td>
<td>3.9</td>
<td>6.1</td>
<td>8.5</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>18.1</td>
<td>31.5</td>
<td>35.8</td>
</tr>
<tr>
<td><strong>% of Total</strong></td>
<td>87%</td>
<td>89%</td>
<td>88%</td>
</tr>
</tbody>
</table>
Of the Total Pilot-Related Accident Causes

60%
Caused by Piloting (Stick and Rudder) Deficiency

28%
Caused by Pilot-in-Command (Cognitive) Deficiency
The Major Pilot-Related *FATAL* Accident Causes

<table>
<thead>
<tr>
<th></th>
<th><em>SEFG</em></th>
<th><em>SERG</em></th>
<th><em>ME</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Take-off/ Climb</td>
<td>12.9</td>
<td>16.9</td>
<td>20.0</td>
</tr>
<tr>
<td>Maneuvering</td>
<td>31.6</td>
<td>16.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Landing</td>
<td>4.5</td>
<td>3.4</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>49.0</td>
<td>37.2</td>
<td>22.5</td>
</tr>
<tr>
<td>Weather</td>
<td>22.6</td>
<td>33.9</td>
<td>47.5</td>
</tr>
<tr>
<td>Fuel Mgmt</td>
<td>1.9</td>
<td>3.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Approaches</td>
<td>9.7</td>
<td>13.6</td>
<td>15.0</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td>34.2</td>
<td>50.9</td>
<td>70.0</td>
</tr>
<tr>
<td><strong>% of Total</strong></td>
<td>83%</td>
<td>83%</td>
<td>93%</td>
</tr>
</tbody>
</table>
Of the Total Fatal Accident Causes

36% 
Caused by Piloting (Stick and Rudder) Deficiency

52% 
Caused by Pilot-in-Command (Cognitive) Deficiency
Of the Total Accident Causes

Piloting Deficiencies
Cause more accidents

Pilot-in-Command Deficiencies
Kill more people
Review
Of All Accident Causes

80% Pilot-Related Causes
Of the Pilot-Related Accident Causes

87% of those

Due to:

• Basic inability to fly the airplane
  Takeoff and Climb
  Maneuvering
  Landing

• Basic inability to act as Pilot-in-Command
  Weather
  Fuel Management
  Approaches
A Pilot-Caused Accident is:

- **5 Times** more likely than mechanical/maintenance failure
- **100 Times** More likely than a mid-air collision
- **200 Times** More likely than a mid-air collision during personal flying
- **300 Times** More likely than a mid-air collision during flight instruction
Of the Total Accident Causes

Piloting Deficiencies
Cause more accidents

Pilot-in-Command Deficiencies
Kill more people
Comparison with Air Carrier Operations
How does General Aviation compare to Air Carriers?

(A good yardstick - probably the best)
## Compare Non-Fatal Accidents per Flight Hour

<table>
<thead>
<tr>
<th></th>
<th>Non-Fatal Accidents</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Aviation</td>
<td>6.876</td>
<td>47</td>
</tr>
<tr>
<td>Air Carrier</td>
<td>0.1434</td>
<td>1</td>
</tr>
</tbody>
</table>

(Per 100,000 hours)

Data from National Safety Council
Compare **Fatal** Accidents per Flight Hour

<table>
<thead>
<tr>
<th></th>
<th>Fatal Accidents (per 100,000 hours)</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Aviation</td>
<td>1.732</td>
<td>53</td>
</tr>
<tr>
<td>Air Carrier</td>
<td>0.0324</td>
<td>1</td>
</tr>
</tbody>
</table>

Data from National Safety Council
Comparison to Air Carrier 1990-1995

Per flight hour* accident rates from 1990-1995 show that GA operations are 50 times more dangerous than air carrier operations.

Data from National Safety Council
Some Questions

Is it reasonable to expect the same level of safety?

- Three times more landings and takeoffs than air carriers
- Extreme variety of missions and flight operations
- Extreme variety of flight and ground equipment
- Extreme variety of airport conditions
- Significantly greater pilot workload
- Less control
- More freedom
- Individual responsibility for determining safety level of ops
Some Questions

Oh?

What if you put the question to your passengers?
Question

Just how careful do GA pilots have to be to reduce the GA accident rate to air carrier levels?
### GA Accident Statistics Reduced to Air Carrier Safety Levels

<table>
<thead>
<tr>
<th>Cause</th>
<th>1995 Accidents</th>
<th>1995 Accidents Reduced to Air Carrier Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preflight/Taxi</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>Takeoff/Climb</td>
<td>388</td>
<td>10</td>
</tr>
<tr>
<td>Weather</td>
<td>153</td>
<td>3</td>
</tr>
<tr>
<td>Fuel Management</td>
<td>141</td>
<td>2</td>
</tr>
<tr>
<td>Other (cruise)</td>
<td>21</td>
<td>1 in 3 years</td>
</tr>
<tr>
<td>Approach</td>
<td>80</td>
<td>2</td>
</tr>
<tr>
<td>Go-around</td>
<td>85</td>
<td>2</td>
</tr>
<tr>
<td>Maneuvering</td>
<td>192</td>
<td>5</td>
</tr>
<tr>
<td>Landing</td>
<td>540</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>49</td>
<td>1</td>
</tr>
</tbody>
</table>
The Answer:

- Real Good
- Real Careful

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Preflight/Taxi</td>
<td>60</td>
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<td>Takeoff/Climb</td>
<td>388</td>
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<tr>
<td>Weather</td>
<td>153</td>
</tr>
<tr>
<td>Fuel Management</td>
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<tr>
<td>Maneuvering</td>
<td>192</td>
</tr>
<tr>
<td>Landing</td>
<td>540</td>
</tr>
<tr>
<td>Other</td>
<td>49</td>
</tr>
</tbody>
</table>
Comparison with Motor Vehicle Operations
Examining Population Statistics (not a good measure)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Fatalities / 100,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle</td>
<td>16.5</td>
</tr>
<tr>
<td>Firearms</td>
<td>13.0</td>
</tr>
<tr>
<td>Falls</td>
<td>5.1</td>
</tr>
<tr>
<td>Poison (L,S)</td>
<td>3.1</td>
</tr>
<tr>
<td>Fire</td>
<td>1.6</td>
</tr>
<tr>
<td>Drowning</td>
<td>1.5</td>
</tr>
<tr>
<td>Choking</td>
<td>1.2</td>
</tr>
<tr>
<td>Poison (G,V)</td>
<td>0.30</td>
</tr>
<tr>
<td>General Aviation</td>
<td>0.24</td>
</tr>
<tr>
<td>Railroad</td>
<td>0.20</td>
</tr>
<tr>
<td>Pedacycle, Streetcar, Horse</td>
<td>0.10</td>
</tr>
<tr>
<td>Air Carrier</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Data from National Safety Council
## Compare Non-Fatal Accidents per Mile Traveled*

<table>
<thead>
<tr>
<th>Cause</th>
<th>Non-Fatal Accidents</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicles</td>
<td>0.274</td>
<td>781</td>
</tr>
<tr>
<td>General Aviation</td>
<td>0.0455</td>
<td>130</td>
</tr>
<tr>
<td>Air Carrier</td>
<td>0.00035</td>
<td>1</td>
</tr>
</tbody>
</table>

Data reduced from the Nall Report, DOT statistics, and National Safety Council

* Per mile basis is probably not a good yardstick for air carrier comparison since air carriers benefit from much higher speed, but it is essentially the only yardstick for motor vehicle comparison.
Compare **Fatal** Accidents per Mile Traveled

<table>
<thead>
<tr>
<th>Cause</th>
<th>Fatal Accidents (per 100,000 miles)</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Aviation</td>
<td>0.0115</td>
<td>144</td>
</tr>
<tr>
<td>Motor Vehicle</td>
<td>0.00183</td>
<td>23</td>
</tr>
<tr>
<td>Air Carrier</td>
<td>0.00008</td>
<td>1</td>
</tr>
</tbody>
</table>

Data reduced from the Nall Report, DOT statistics, and National Safety Council
General Aviation vs. Motor Vehicle

- 5 times more likely to get injured in the car
- 5 times more likely to get killed in the GA airplane.
Summary

Measured by Total, Non-Fatal, and Fatal Accidents per Flight Hour:

General aviation is about 50 times more dangerous than air carriers.

Measured by Non-Fatal Accidents per Mile:

General aviation is about 5 times safer than motor vehicle travel.

Measured by Fatal Accidents per Mile:

General aviation is about 5 times more dangerous than motor vehicle travel.
The Point

- Statistics reflect the current training standards and piloting practices

- Without a rededicated effort by flight instructors and command pilots to elevate the level of basic piloting skills and basic pilot-in-command skills ...

... it is 5 times safer to drive and 50 times safer to fly commercial.
Implications for General Aviation Flight Instructors
Flight Instructors’ Assignment

• Expand our ground school program to emphasize:
  • Motivation
    80/87
    5/50
  • Basic pilot-in-command training
    Weather, Fuel Management, Approaches
    PIC Responsibilities
    Procedures
    Judgement
    Vigilance
    Leadership
Flight Instructors’ Assignment

• Re-energize our flight training program to elevate our standards for:
  • Performance
    Higher performance expectations for both instructor and student
  • Basic Airplane Handling Techniques
    Takeoff and climb
    Maneuvering
    Landing
We must teach “80/87”.
Basic Safety Statistics

That 80% of all accidents have pilot-related causes. That 87% of those are due to:

**BASIC piloting deficiencies:**
- Takeoff and Climb
- Maneuvering
- Landing

**BASIC pilot-in-command deficiencies:**
- Weather
- Fuel management
- Approaches
We must *teach* “5/50”.
Basic Safety Statistics

That without continuing effort by the command pilot to elevate his piloting skills and pilot-in-command procedures, it is 5 times safer to drive and 50 times safer to fly commercial.

That if they cannot generate the discipline to be the command pilot of a passenger carrying airplane, they are better off on the ground or with a recreational pilot’s license.