Risk Compensation in General Aviation: The Effect of Ballistic Parachute Systems

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Background

- FAA Certified Flight Instructor
- Commercial Pilot (ASEL, AMEL)
- Lecturer in the Aviation Sciences Program at the University of Maryland Eastern Shore
  - Teach courses in Human Factors, Advanced Aircraft Systems, Pilot Ground Schools
Ballistic Parachute Systems

- CAPS – Cirrus Airframe Parachute System
- Safety Enhancing Device
- To be deployed in an emergency situation:
  - mid-air collisions
  - pilot incapacitation
  - loss of control
  - engine failure over rough terrain
  - engine failure at night
- However – these types of accidents are statistically rare compared to other accident causes.
2005 Nall Report - Aircraft Owners and Pilots Association (AOPA)

- Summary, statistics and analysis of General Aviation Accidents:
  - Mid Air Collisions – “relatively rare”
  - Pilot Incapacitation – “happens very rarely”
  - Failure of Aircraft or Systems – also rare

- More common are “human” causes
  - “Improper action or inaction by the pilot”
    - 75.5% of all accidents
    - 78.6% of all fatal accidents
# NTSB Query of Fatal Accidents in Cirrus Design Aircraft through November 2010

72 records meet your criteria. A docket of supporting materials may exist for factual and probable cause reports. Please contact Records Management Division. Dockets are not available for preliminary reports.

PDF Reports require the free Adobe Reader for viewing.

<table>
<thead>
<tr>
<th>Current Synopsis</th>
<th>Report(s) (Published)</th>
<th>Event Date</th>
<th>Probable Cause Released</th>
<th>Location</th>
<th>Make / Model</th>
<th>Regist. Number</th>
<th>Event Severity</th>
<th>Type of Air Carrier Operation and Carrier Name (Doing Business As)</th>
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</table>

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Risk Compensation

• The theory that persons adapt their behavior based on their perceived risk. When humans perceive that risk or danger has increased, they will act more cautiously. Conversely, when risk is perceived to be less or a person *feels* safer, he or she will behave less cautiously.

  ▫ **Examples:**
    • Bicycling
    • Driving
    • Children’s Safety Gear
    • Cell phones and driving
    • Aviation?
Risk Compensation cont...

• Hypothesis
  ▫ Pilots, when confronted with hypothetical situations, will make riskier decisions when their hypothetical aircraft is equipped with a ballistic parachute system than would pilots not equipped with such a system.
Methods

- Two groups of pilots, split randomly, given a pre-existing risk assessment tool.
  - Risk assessment tool developed by Driskill et al. (FAA – 1998)
    - Proposed scenarios and gave multiple choice options
    - Options had been ranked for risk by SMEs.
    - Each pilot could then be assigned a “risk score”
    - Safety Deviation Index (SDI)
  - One group was told they were flying a traditionally equipped aircraft, the other was told they were flying an aircraft equipped with a ballistic parachute system.
    - Avionics and all other equipment were the same
Example Scenario

24. You are halfway in a two hour late evening flight from the Regional Airport cruising at 4500 feet over a route with an MEA of 1500 feet. The weather has been clear as forecast when without any warning you find yourself in a cloud. You decide to:

A) Continue straight ahead for a while and see what happens.

B) Make a 180 degree level turn and get out.

C) Start a wings level shallow descent to get under it.

D) Start a wings level climb to get on top.
Opinion Questions

- The opinion questions instructed pilots to rate the level to which they agreed with two separate statements using a 5-point Likert scale.
- The statements were:
  - I feel that the airplane I am flying, considering its type, condition, and equipment installed, impacts the amount of risk I am willing to accept on a given flight.
  - I feel that I may be willing to take on greater risks when flying an aircraft equipped with a ballistic parachute system than I would in an aircraft without a ballistic parachute system.
Limitations

- Small sample size (n=76)
- Available population
- Original tool designed for VFR-only pilots
  - Instrument rated pilots would have “better” options
- Paper Simulation
  - Pilot responses may be very different in the real world
Safety Deviation Index (SDI)

- Higher SDI means riskier decisions
- VFR only pilots:
  - Cirrus pilots made riskier decisions than Piper pilots
  - Not statistically significant given small sample size
- Pilots with the greatest flight time, those reporting more than 5,000 hours, have the highest overall SDI score with a mean of 455.2

<table>
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<tr>
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<th>Mean SDI</th>
<th>N</th>
<th>Std. Deviation</th>
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<tbody>
<tr>
<td><strong>VFR-only pilots</strong></td>
<td></td>
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<tr>
<td>Cirrus Group</td>
<td>418.2327</td>
<td>15</td>
<td>79.13213</td>
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<td>Piper Group</td>
<td>400.1483</td>
<td>18</td>
<td>65.67336</td>
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<tr>
<td>Total</td>
<td>408.3685</td>
<td>33</td>
<td>71.51555</td>
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<tr>
<td><strong>Instrument-rated pilots</strong></td>
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<td></td>
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<tr>
<td>Cirrus Group</td>
<td>410.4479</td>
<td>19</td>
<td>92.79381</td>
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<tr>
<td>Piper Group</td>
<td>447.6967</td>
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<td>98.50094</td>
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<tr>
<td>Total</td>
<td>431.2379</td>
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<td>96.71535</td>
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<tr>
<td><strong>Total (All respondents)</strong></td>
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<tr>
<td>Cirrus Group</td>
<td>413.8824</td>
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<tr>
<td>Piper Group</td>
<td>427.3188</td>
<td>42</td>
<td>88.30812</td>
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<tr>
<td>Total</td>
<td>421.3078</td>
<td>76</td>
<td>86.89384</td>
</tr>
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</table>

Table 1 Instrument rated versus VFR-only pilot’s SDI scores
Opinion Questions 1

• “I feel that the airplane I am flying, considering its type, condition, and equipment installed, impacts the amount of risk I am willing to accept on a given flight.”
  ▫ Overall agreement: 3.58.
    • VFR-only pilots: 3.36
    • Instrument-rated pilots: 3.74
Opinion Question 2

• “I feel that I may be willing to take on greater risks when flying an aircraft equipped with a ballistic parachute system than I would in an aircraft without a ballistic parachute system.”
  ▫ Overall disagreement : 1.68
      • VFR-only pilots: 1.97
      • VFR-only Cirrus Group: 2.13.
Correlations

- Examined SDI scores and opinion question responses for correlations with demographic data
- Statistically significant correlations between Opinion Question 2 response and Age/Total Flight Time
- No other significant correlations
Applications

• Training
• Decision support systems / automation
  ▫ Must understand decision making in order to support it
    • i.e. DECIDE model of decision making
  ▫ Must be “enlightened” by scientific research
    • Research vs. Sales driven
• More safety devices may not always be better?
Future Study

- Duplication of paper study with larger sample size.
- Use of Flight Simulation for enhanced study of pilot decision making/risk taking
Questions?