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

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ENRI International Workshop on ATM/CNS – EIWAC 2010

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.

Current Synopsis	PDF Report(s) (Published)	Event Date	Probable Cause Released	Location	Make / Model	Regist. Number	Event Severity	Type of Air Carrier Operation and Carrier Name (Doing Business As)
Preliminary	Preliminary(10/27/2010)	10/21/2010		Agua Dulce, CA	CIRRUS DESIGN CORP SR22	N427MC	Fatal(3)	Part 91: General Aviation
Preliminary	Preliminary(8/12/2010)	8/4/2010		Phoenix, AZ	CIRRUS DESIGN CORP SR22	N146CK	Fatal(1)	Part 91: General Aviation
Preliminary	Preliminary(7/17/2010)	7/12/2010		Chapel Hill, NC	CIRRUS SR20	N527MJ	Fatal(1)	Part 91: General Aviation
Preliminary	Preliminary(7/9/2010)	7/5/2010		Caldwell, NJ	CIRRUS DESIGN CORP SR22	N764CD	Fatal(3)	Part 91: General Aviation
Factual	Factual(6/8/2010)	5/31/2010		Bielefeld, Germany	CIRRUS SR22	SP-AVC	Fatal(4)	Non-U.S., Non-Commercial
Preliminary	Preliminary(5/14/2010)	5/10/2010		Tuscaloosa, AL	CIRRUS DESIGN CORP SR22	N424LF	Fatal(2)	Part 91: General Aviation
Factual	Factual(11/5/2010)	3/19/2010		Morton, WA	CIRRUS DESIGN CORP SR22	N224GS	Fatal(1)	Part 91: General Aviation
Preliminary	Preliminary(2/11/2010)	2/6/2010		Boulder, CO	CIRRUS DESIGN CORP SR20	N825BC	Fatal(3)	Part 91: General Aviation
Preliminary	Preliminary(1/11/2010)	12/15/2009		Gulf of Mexico, GM	CIRRUS SR22	N723LJ	Fatal(1)	Part 91: General Aviation
Factual	Factual(12/21/2009)	12/10/2009		Oberbarnim, Germany	CIRRUS SR20	D-EYAT	Fatal(1)	Non-U.S., Non-Commercial

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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.

◯ A ◯ B ◯ C ◯ D

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)

		Mean SDI	N	Std. Deviation
VFR-only pilots	Cirrus Group	418.2327	15	79.13213
	Piper Group	400.1483	18	65.67336
	Total	408.3685	33	71.51555
Instrument-rated pilots	Cirrus Group	410.4479	19	92.79381
	Piper Group	447.6967	24	98.50094
	Total	431.2379	43	96.71535
Total (All respondents)	Cirrus Group	413.8824	34	85.84110
	Piper Group	427.3188	42	88.30812
	Total	421.3078	76	86.89384

Table 1 Instrument rated versus VFR-only pilot's SDI scores

- 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

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

	Age	Cirrus or Piper Group	Total flight time
SDI	-.177	.077	.103
Opinion Question 1	-.099	-.026	.163
Opinion Question 2	-.227*	-.068	-.241*

Table 2 Correlations with Demographic Data

* Correlation is significant at the 0.05 level (2-tailed)

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?