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Interpreting Aviation Weather Products: Follow-up study with AOPA Members

Beth Blickensderfer
Embry-Riddle Aeronautical University, blick488@erau.edu

Thomas A. Guinn
Embry-Riddle Aeronautical University, guinnt@erau.edu

Thomas Bob
Embry-Riddle Aeronautical University

Jayde King
Embry-Riddle Aeronautical University

Yolanda Ortiz
Embry-Riddle Aeronautical University

See next page for additional authors

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Author / Researcher / PI

Beth Blickensderfer, Thomas A. Guinn, Thomas Bob, Jayde King, Yolanda Ortiz, Nick DeFilippis, Quirijn Berendschot, and Jacqueline McSorley

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Interpreting Aviation Weather Products:
Follow-up study with AOPA Members

Faculty Researchers:
Beth Blickensderfer, Ph.D.
Tom Guinn, Ph.D.
Bob Thomas, M.S., Ph.D.

Graduate Research Assistants:
Jayde King, M.S.
Yolanda Ortiz, M.S.
Nick DeFilippis, M.S.
Quirijn Berendschot, M.S.A.
Jacqueline McSorley, M.S.

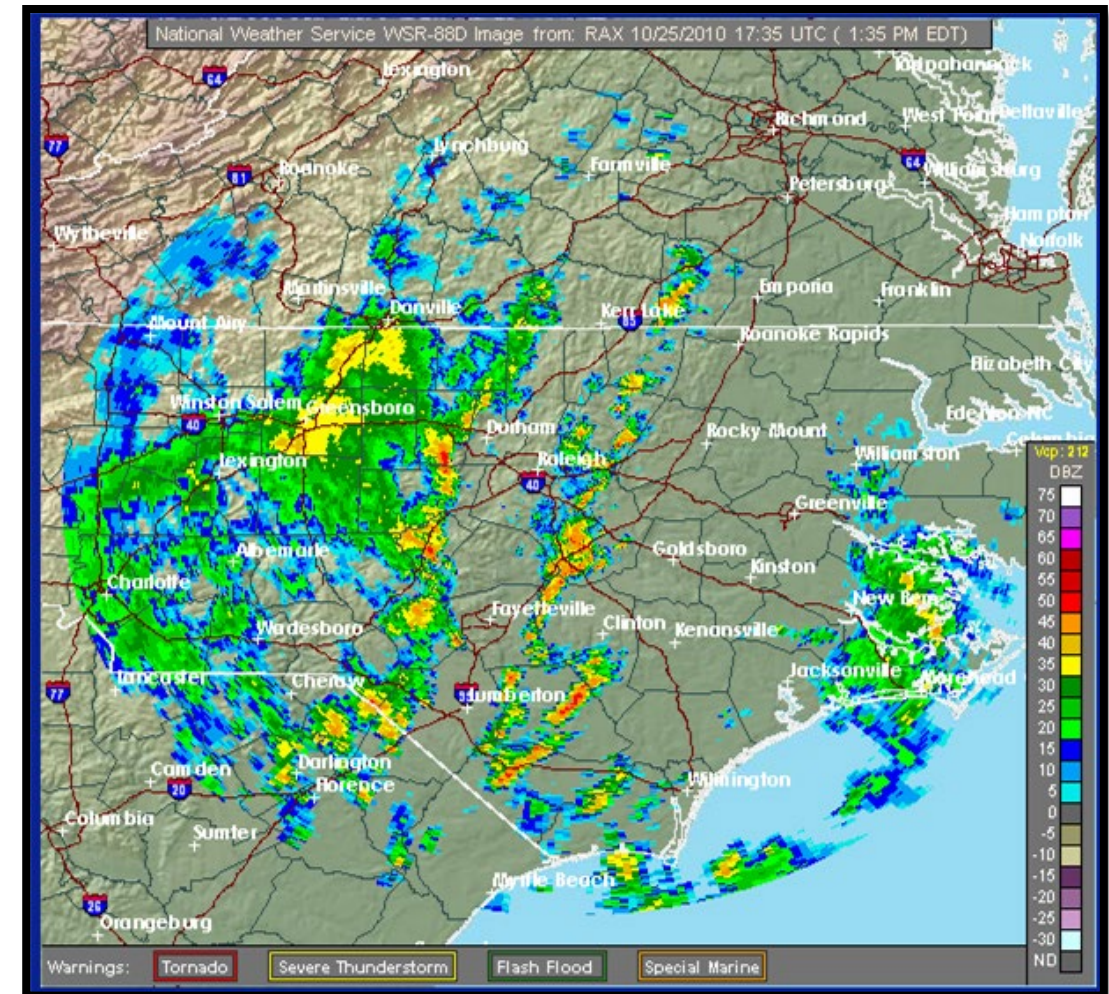October 17, 2018

Outline

➢ Background

➢ Method

➢ Results

➢ Discussion

Aviation Weather Product Interpretation Research

- Purpose
  - Use the questions we developed in Phase I
  - Include pilots that are more representative of GA (age, flight hours/experience); Collaborate with AOPA
  - Examine: Knowledge about aviation weather products; Differences between levels of flight certificate and/or ratings

"The older generation"

your freedom to *fly*

Study Design

1. Coordinated with Rune Duke

2. 118 questions divided into 5 Tests/Surveys;

3. Study protocol approved by ERAU IRB

4. Implemented the 5 separate online surveys/tests (Qualtrics)

5. AOPA sent out the survey 3 times (June 2017, August 2017, September 2017)

118 Questions Divided into 5 Tests

Test 1
- Data Source (5)
- Flight Planning (5)
- Storm Definition (5)
- Significant Weather (5)

Test 2
- Metar (8)
- TAF (6)
- Winds Aloft (5)
- Pirep (6)

Test 3
- G-Airmet (13)
- GTG (5)
- CIP (5)

Test 4
- Radar (12)
- Sigmet (7)
- TSTM (5)

Test 5
- Satellite (7)
- Station Plots (6)
- Surface Prog (5)
- CVA (5)

Participants

- More than 1000 pilots began the survey

- 837 pilots completed the whole survey and were included in analysis
  - Private pilot (Private)
  - Private pilot with instrument rating (Private with Instrument)
  - CPL with instrument (Commercial with Instrument)
  - CFI or CFII or anyone with additional certificates (CFI)
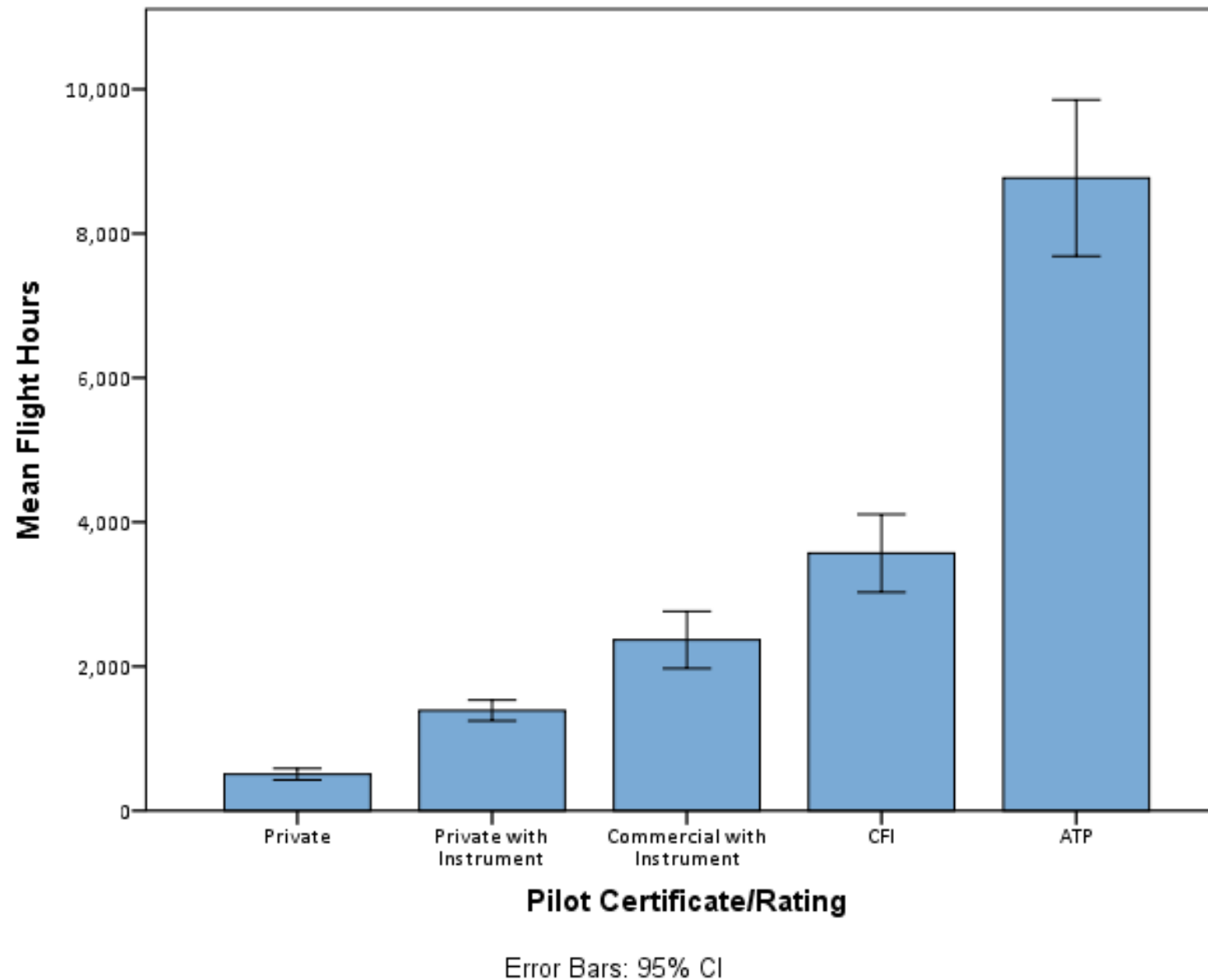 - ATP (ATP)

Sample Size

Participant age

M(SD) = 57 (13.8)

	Test 1 n	Test 2 n	Test 3 n	Test 4 n	Test 5 n	Total N
Private	69	35	40	55	49	**248**
Private w/ Instrument	41	47	55	46	51	**240**
Commercial w/ Instrument	39	22	11	29	33	**134**
ATP	22	24	24	7	23	**100**
CFI	35	21	19	22	18	**115**
Total	**206**	**149**	**149**	**159**	**174**	**837**

Locations

Participant Mean Flight Hours

Error Bars: 95% CI
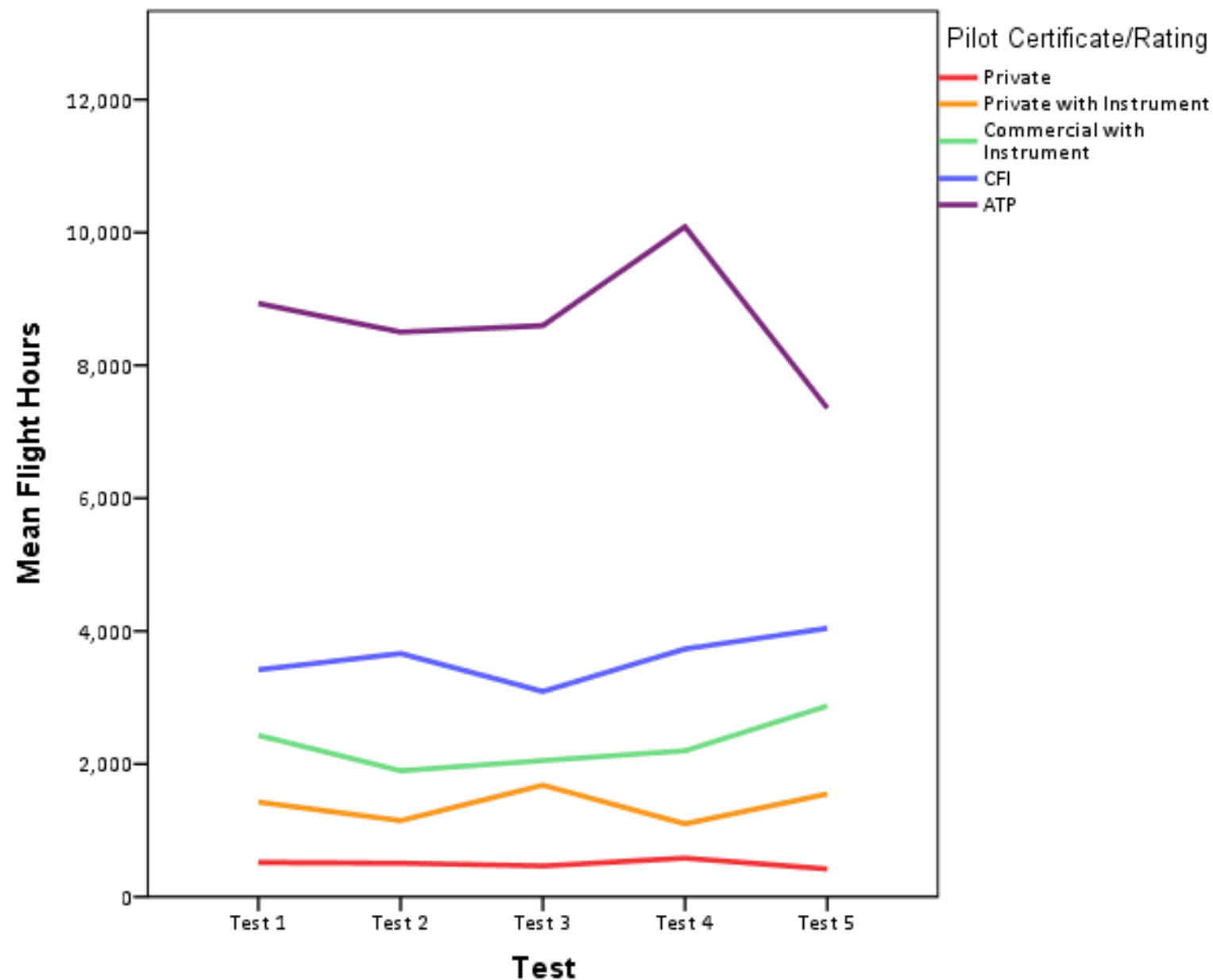
There was a significant main effect for rating on flight hours,
$F_{(4,850)} = 196.99$, $p < 0.01$, partial eta squared = 0.48

Overall Flight Hours by Test

No significant interaction between test number and pilot rating on flight hours, $F_{(16, 850)} = 1.07$, $p = 0.38$, partial eta squared = 0.02

Results

Overall Analysis

A 5x5 Between Groups ANOVA
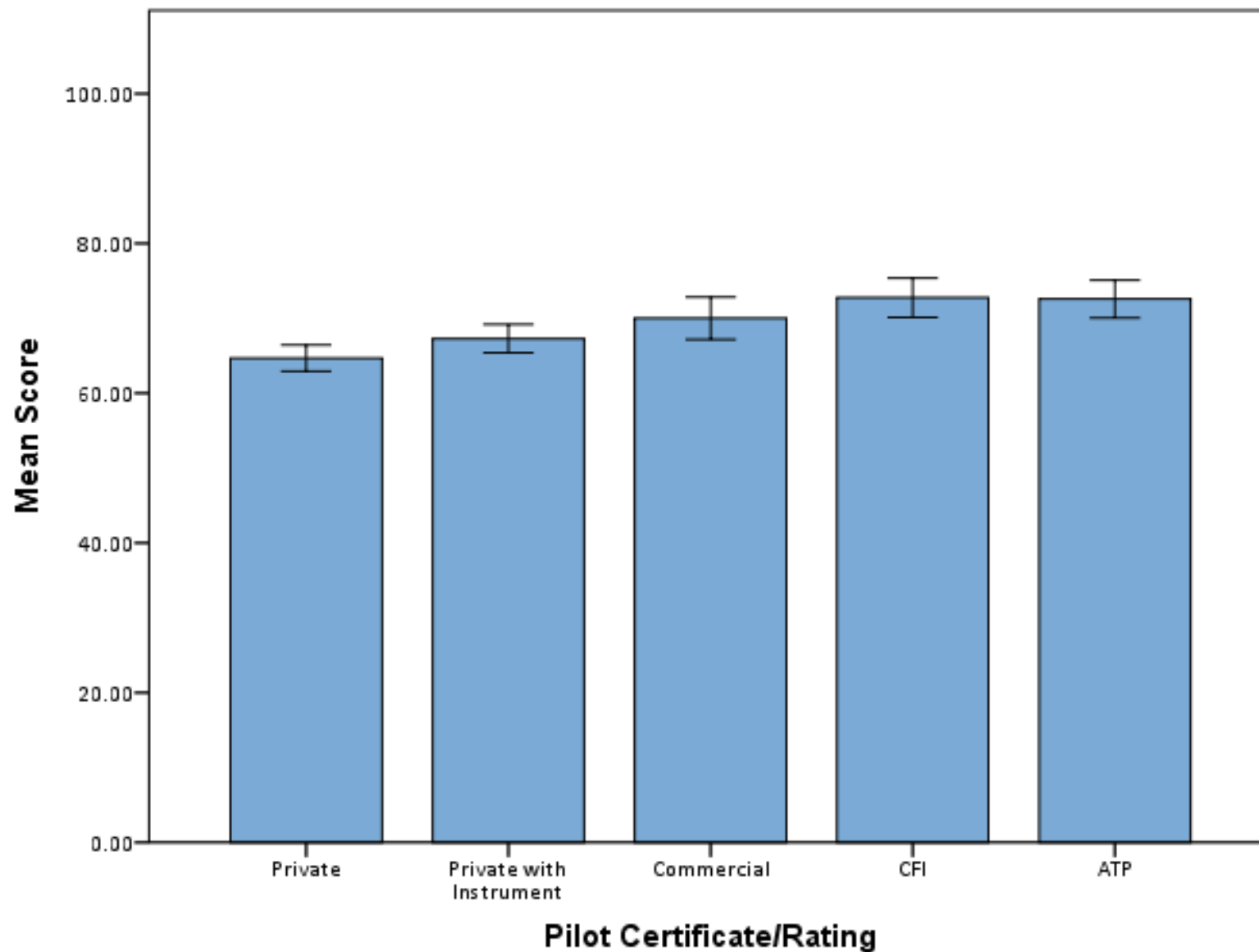
Independent Variable 1: Test
(Test 1 vs. Test 2 vs. Test 3 vs. Test 4 vs. Test 5)

Independent Variable 2: Pilot Rating
(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

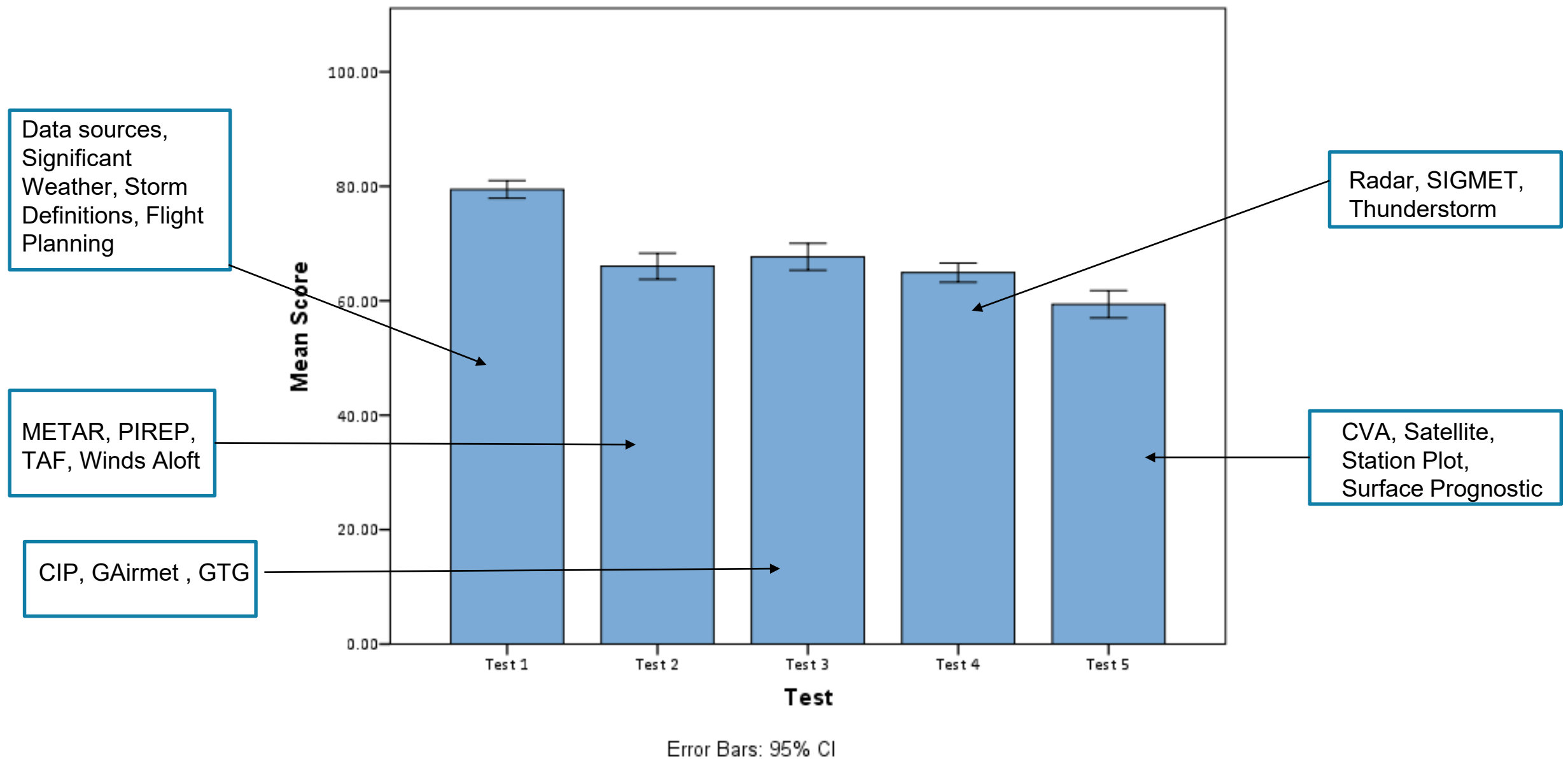Dependent variable: Percent Correct (Score)

# Effect of Rating on Score

Error Bars: 95% CI

There was a significant main effect of pilot certificate/rating on score, $F(4, 857) = 12.48$, $p < 0.01$, partial eta squared = 0.55.

Effect of Test on Score

Data sources, Significant Weather, Storm Definitions, Flight Planning

Radar, SIGMET, Thunderstorm

METAR, PIREP, TAF, Winds Aloft

CVA, Satellite, Station Plot, Surface Prognostic

CIP, GAirmet , GTG

Error Bars: 95% CI

There was a significant main effect of test on score
$F (4, 857) = 53.39$, $p < 0.01$ partial eta squared = 0.20.

Interaction graph
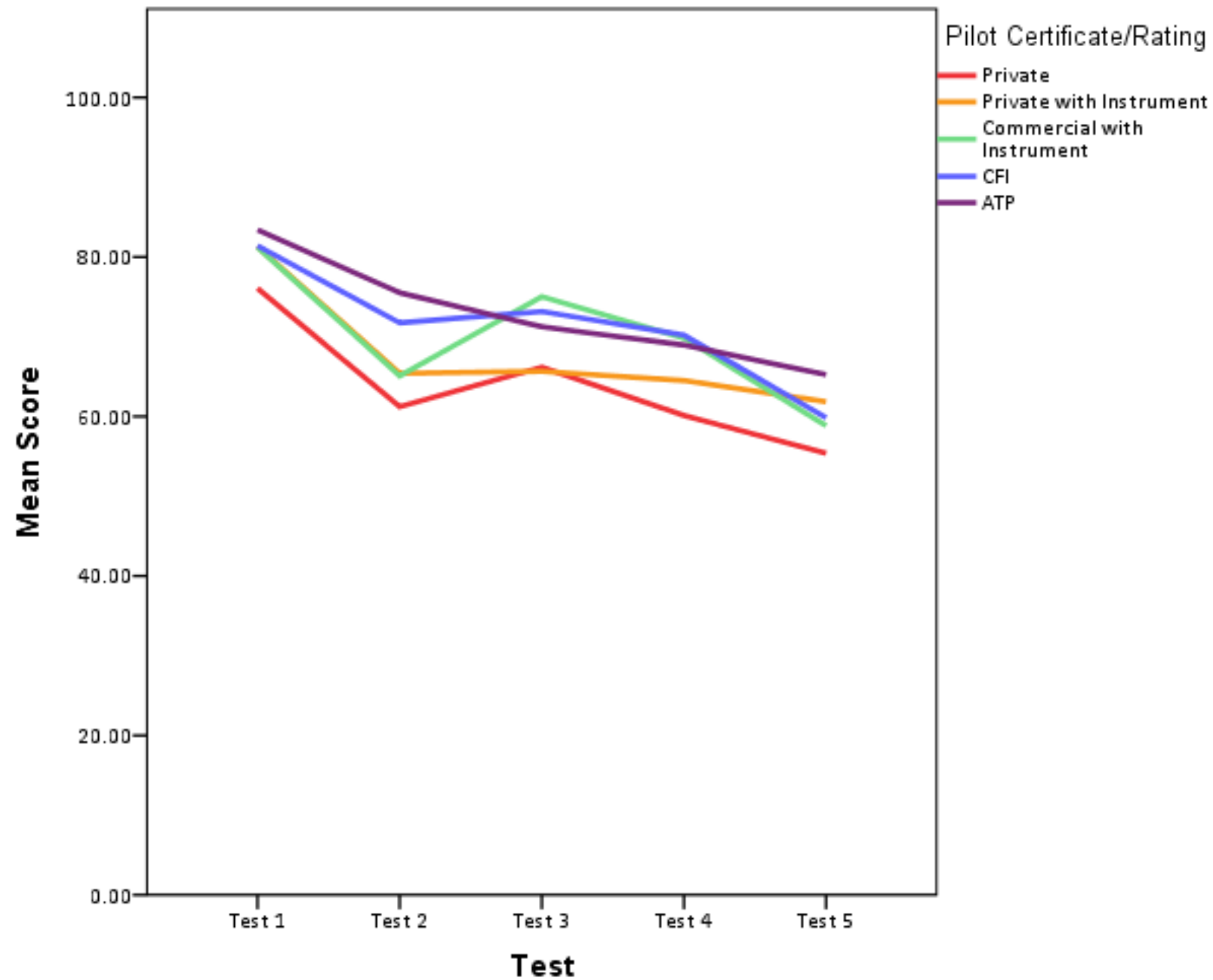
The interaction was not significant, $F_{(16, 857)} = 1.11$, $p = 0.338$, partial eta squared = 0.02.

Test 1 Analysis

A 4x5 Mixed ANOVA

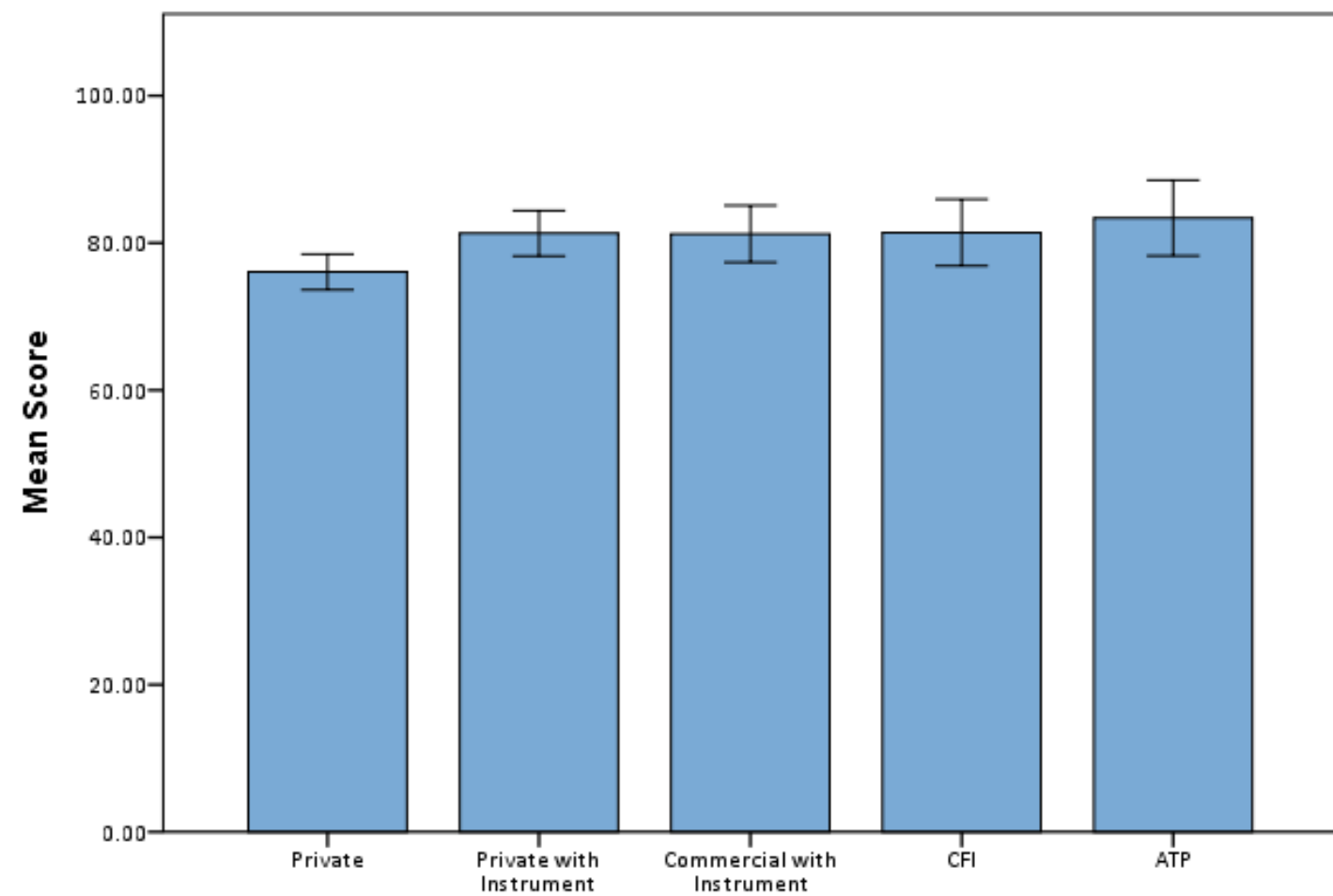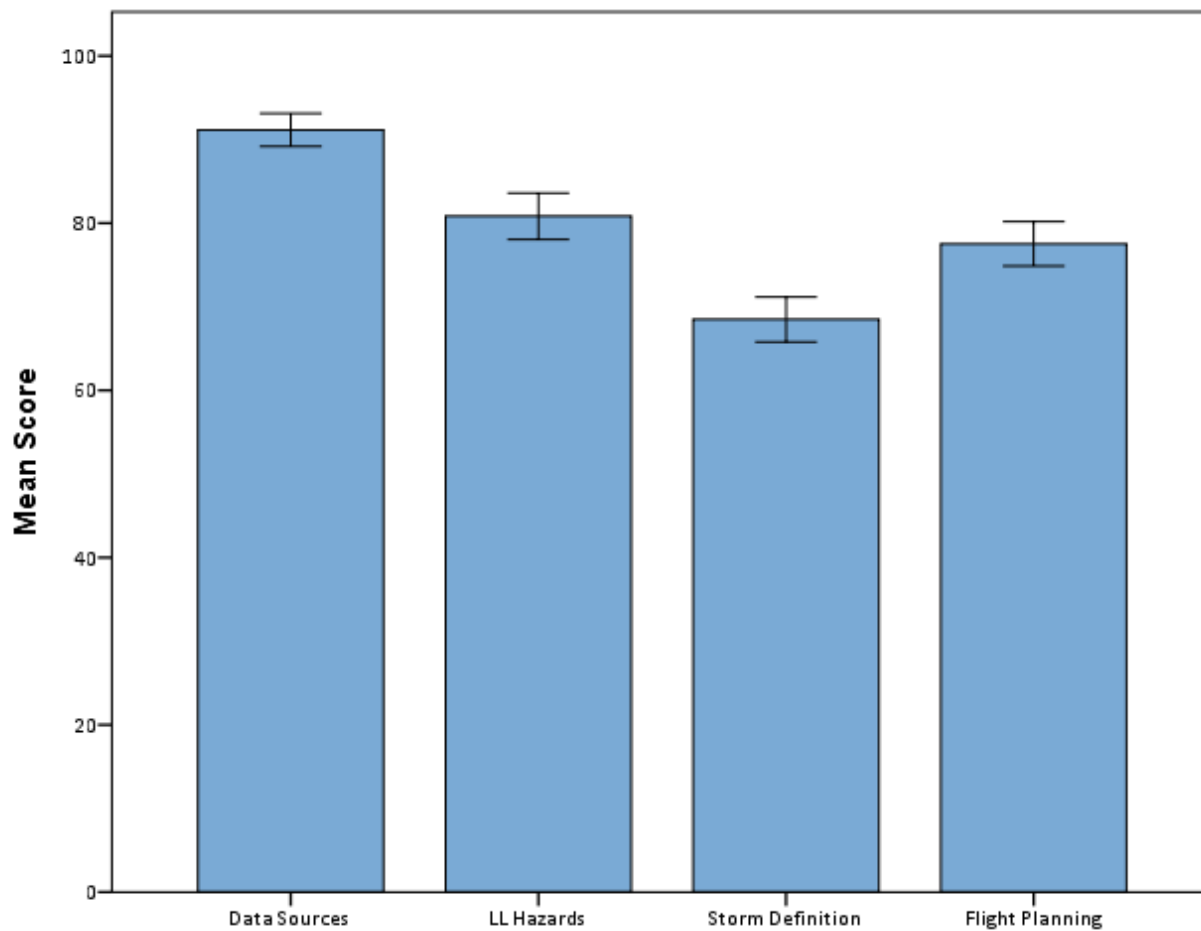Independent Variable 1: Topics within Test 1
   (Data sources vs. Significant Weather vs. Storm Definitions vs. Flight Planning)

Independent Variable 2: Pilot Rating
   (Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

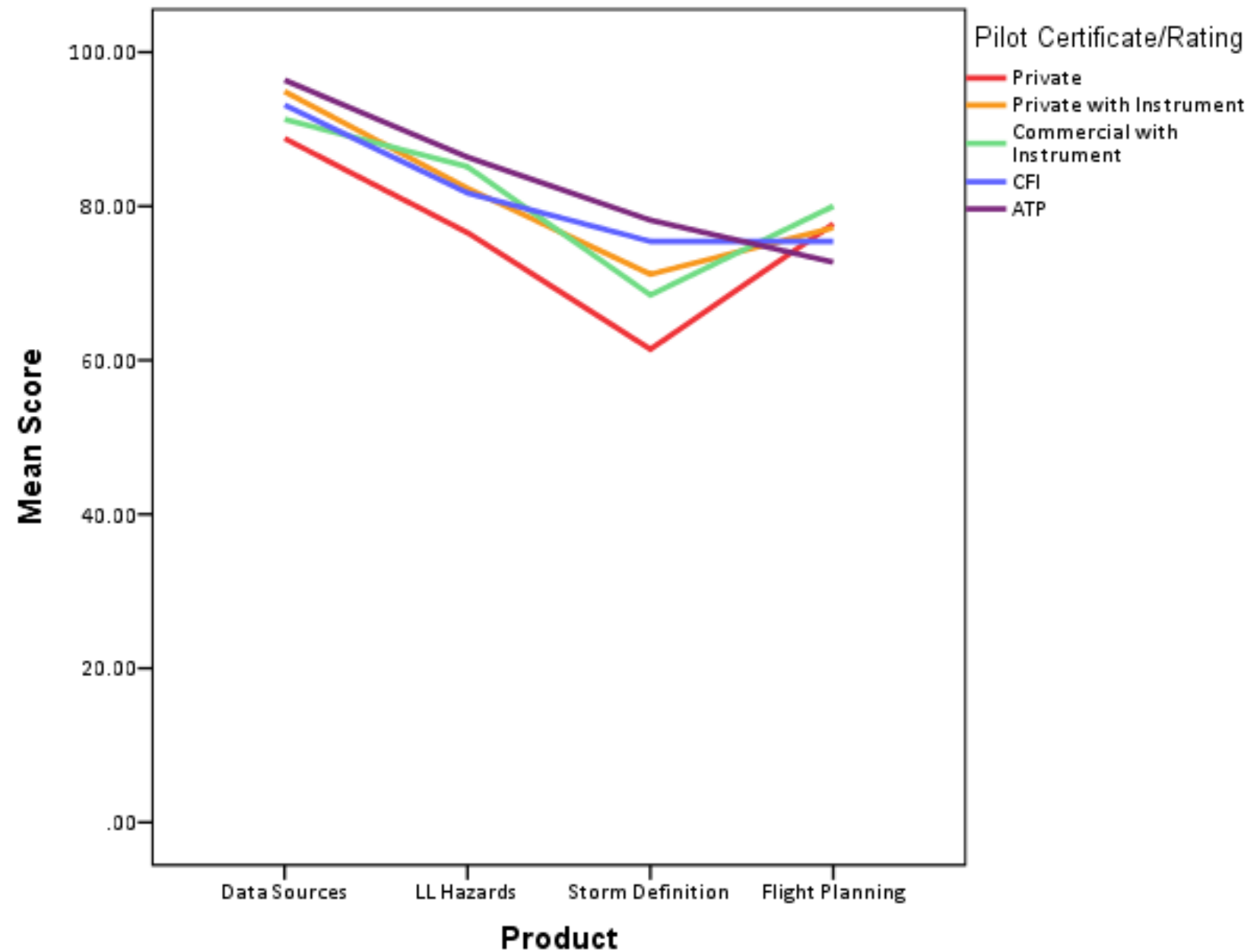   Dependent variable: Percent Correct (Score)

Test 1

Significant main effect of Product type on Test 1 score,

Wilks' Lambda = 0.46, $F_{(3, 202)} = 78.29$, $p > 0.01$. Partial

eta squared = 0.54.

Significant main effect of Pilot Rating on Test 1 score,

$F_{(4, 204)} = 3.03$, $p = 0.02$, partial eta squared = 0.06.

Test 1

No significant interaction of Pilot Rating and Topic on Score

Wilks' Lambda = 0.90, F (12, 534.7) = 1.76, p = 0.053, partial eta squared = 0.03
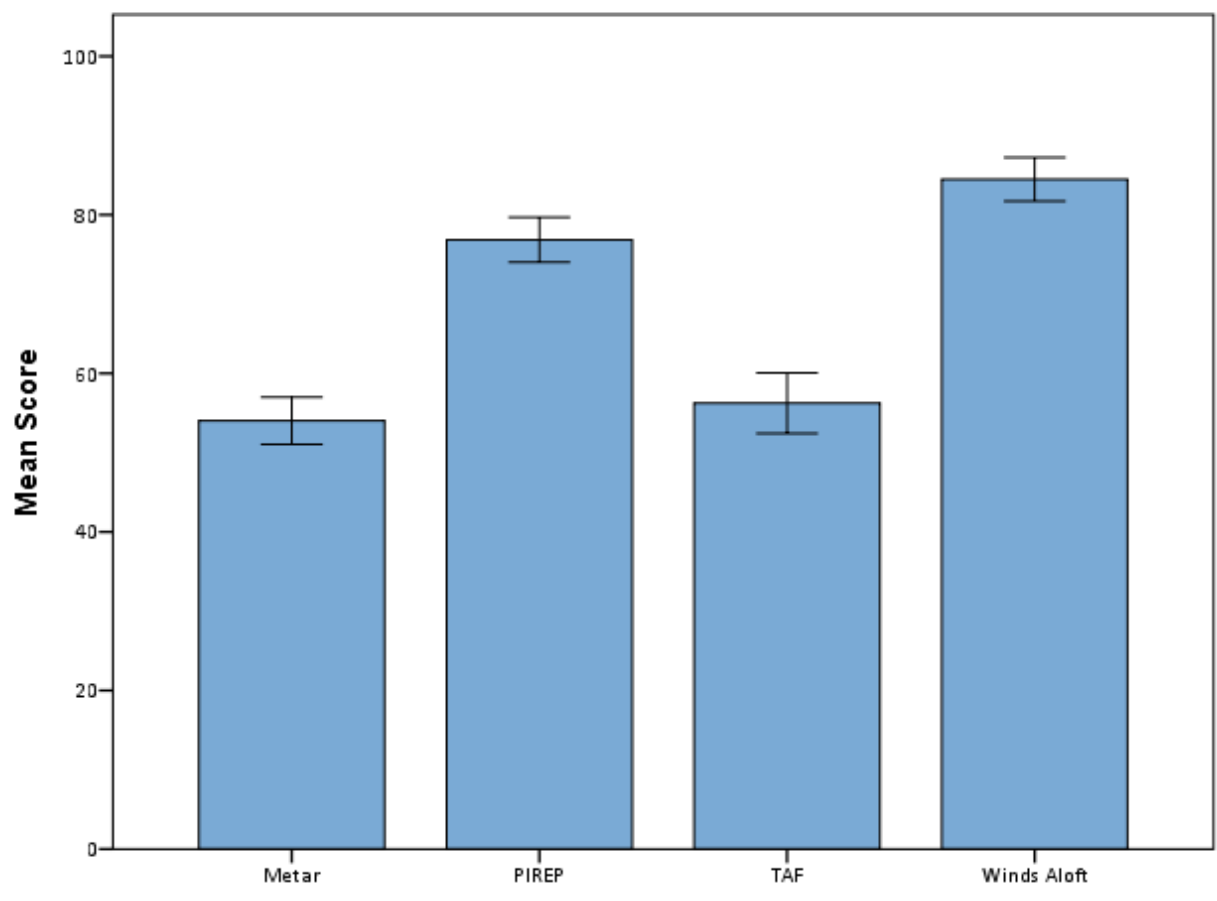
Test 2 Analysis

A 4x5 Mixed ANOVA

Independent Variable 1: Topics within Test 2
   (METAR vs. PIREP vs. TAF vs. Winds Aloft)
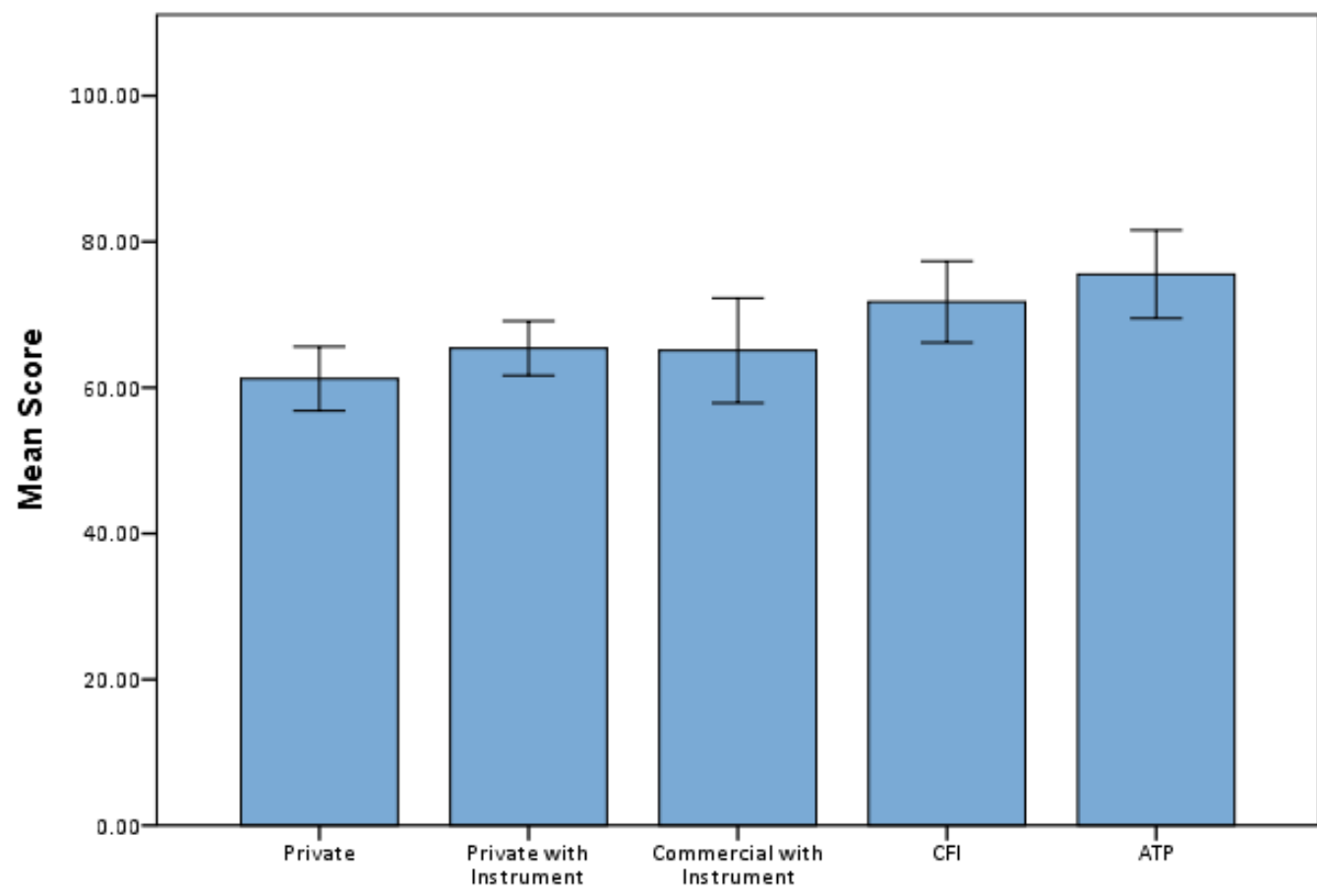
Independent Variable 2: Pilot Rating
   (Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

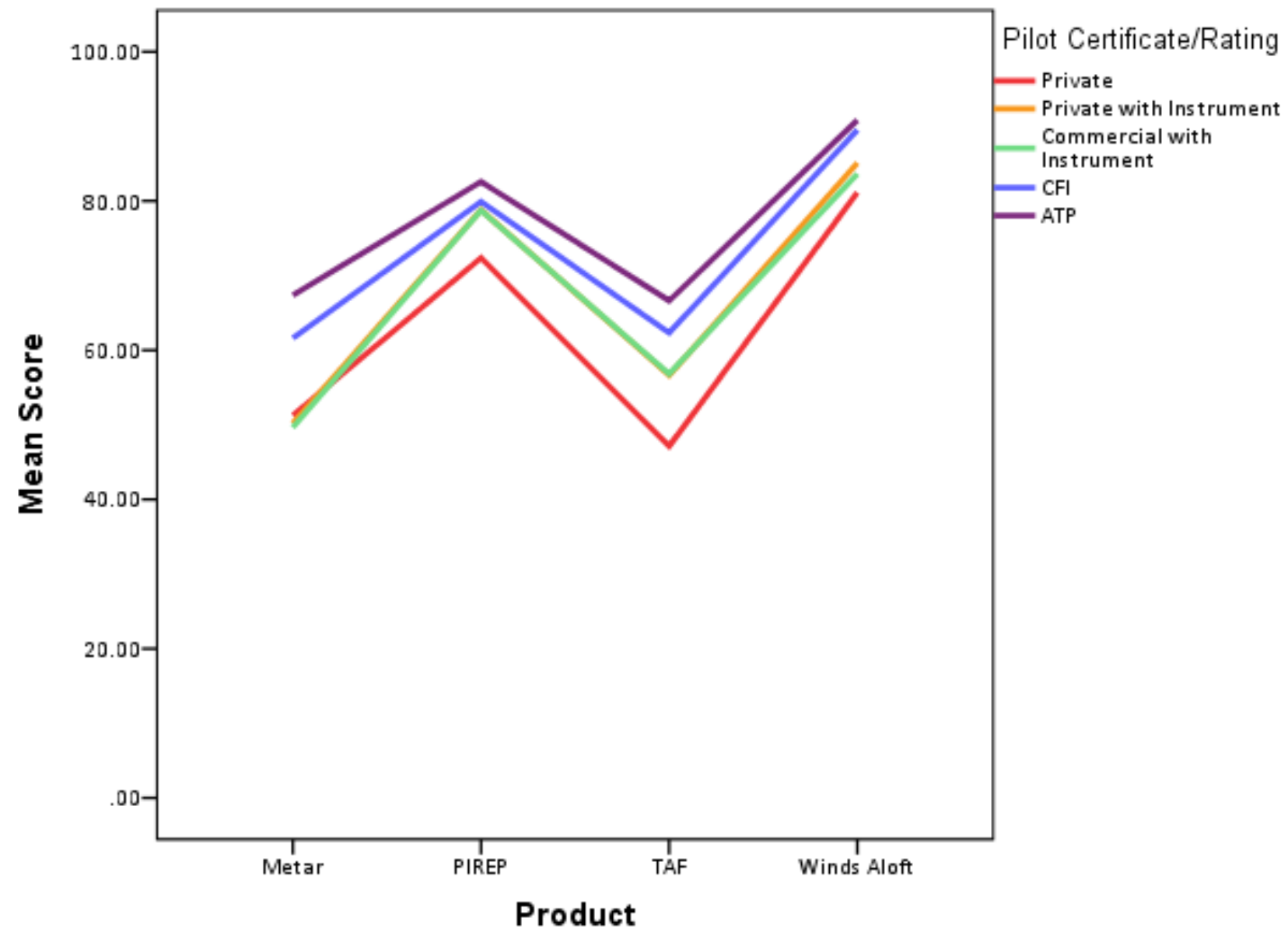   Dependent variable: Percent Correct (Score)

Test 2

Significant main effect of product on Test 2 Score,

Wilks' Lambda = .30, $F_{(3, 142)} = 110.63$, $p < 0.01$, partial eta squared = 0.70

Significant main effect for Pilot Rating on Test 2 score,

$F_{(4, 144)} = 4.67$, $p = 0.01$, partial eta squared = 0.12

Test 2

No significant interaction for Product and Pilot Rating/Certificate on Test 2 score,

Wilks' Lambda = .91, $F_{(12, 375.99)}$ = 1.16, p = 0.313, partial eta squared = 0.03.
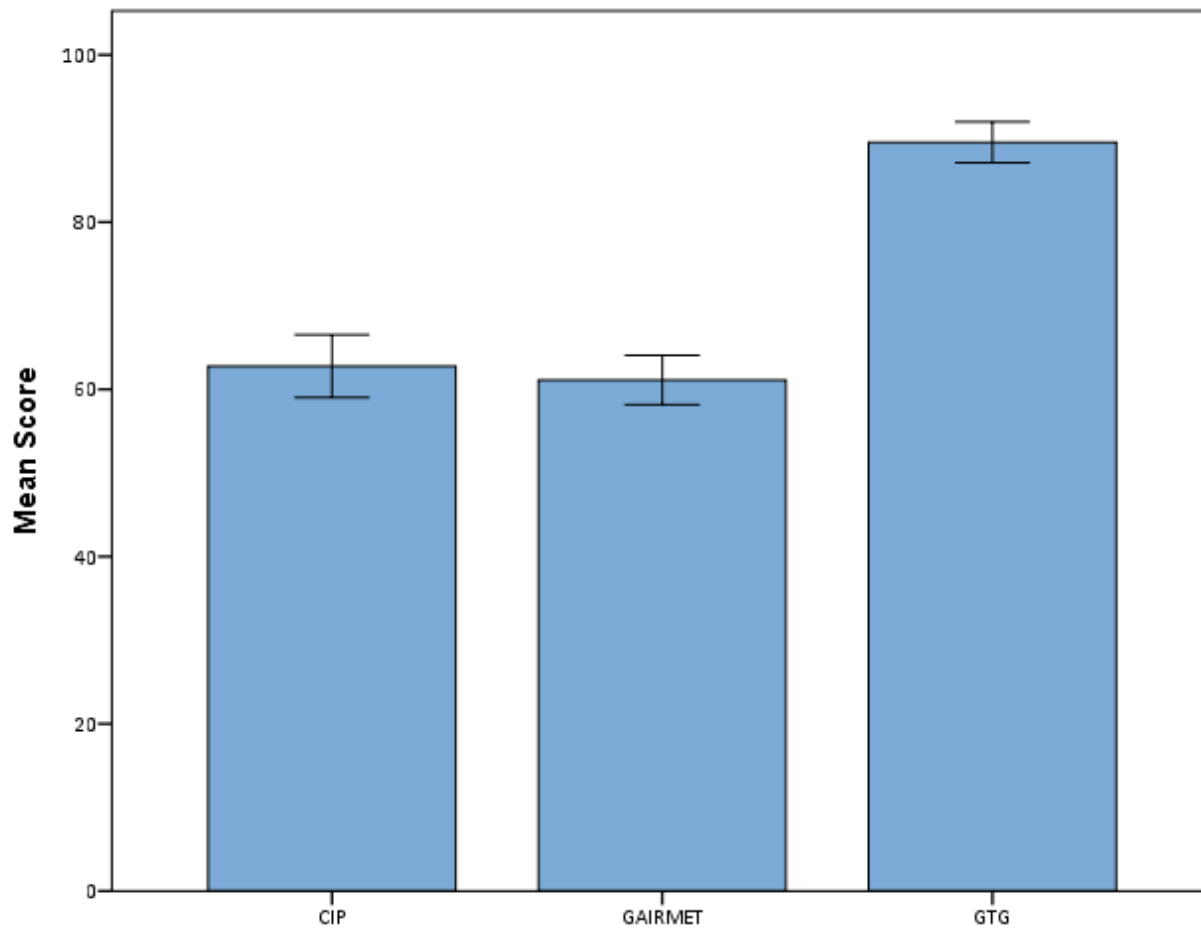
Test 3 Analysis

A 3x5 Mixed ANOVA

Independent Variable 1: Topics within Test 3
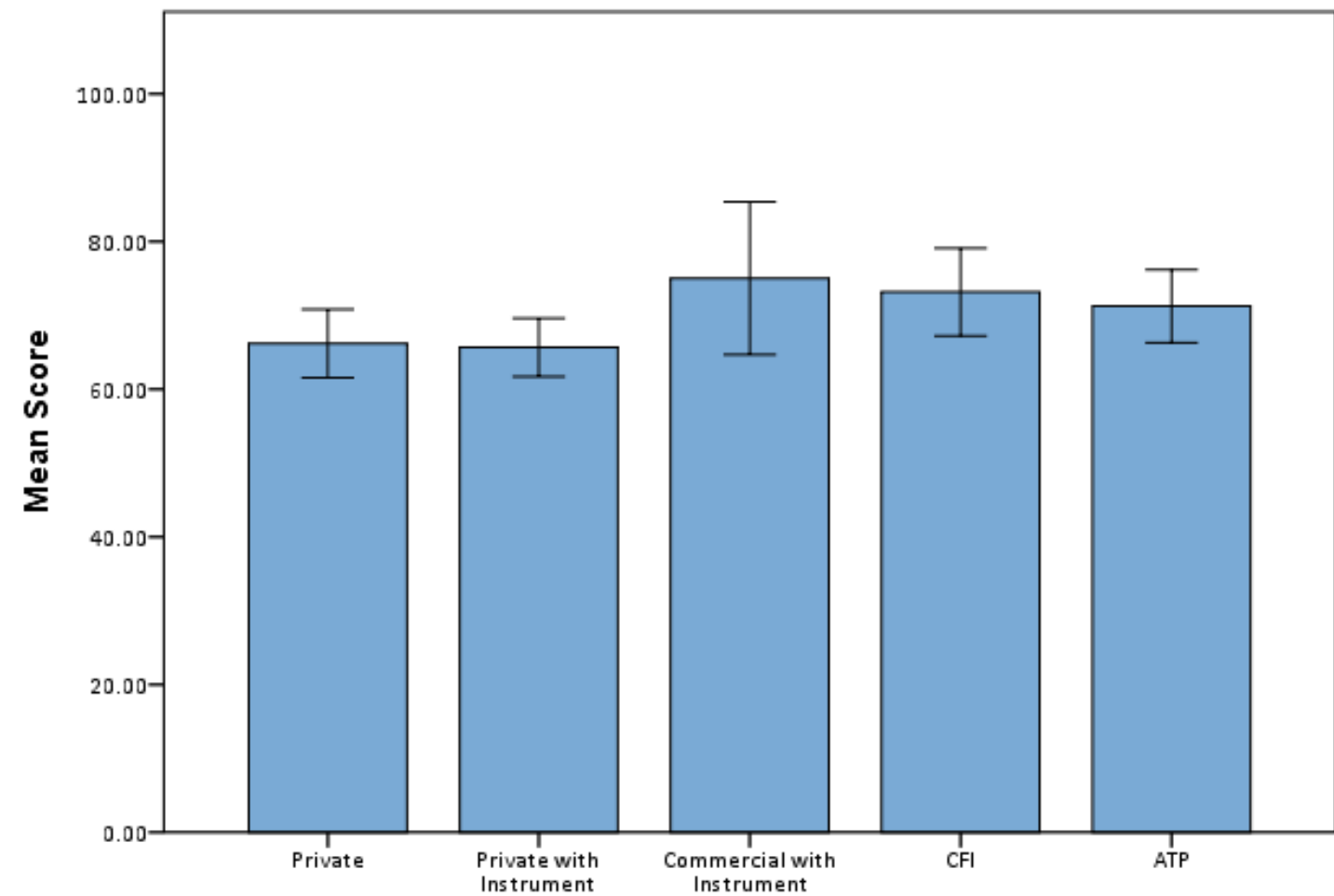   (CIP vs. GAirmet vs. GTG)

Independent Variable 2: Pilot Rating
    (Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

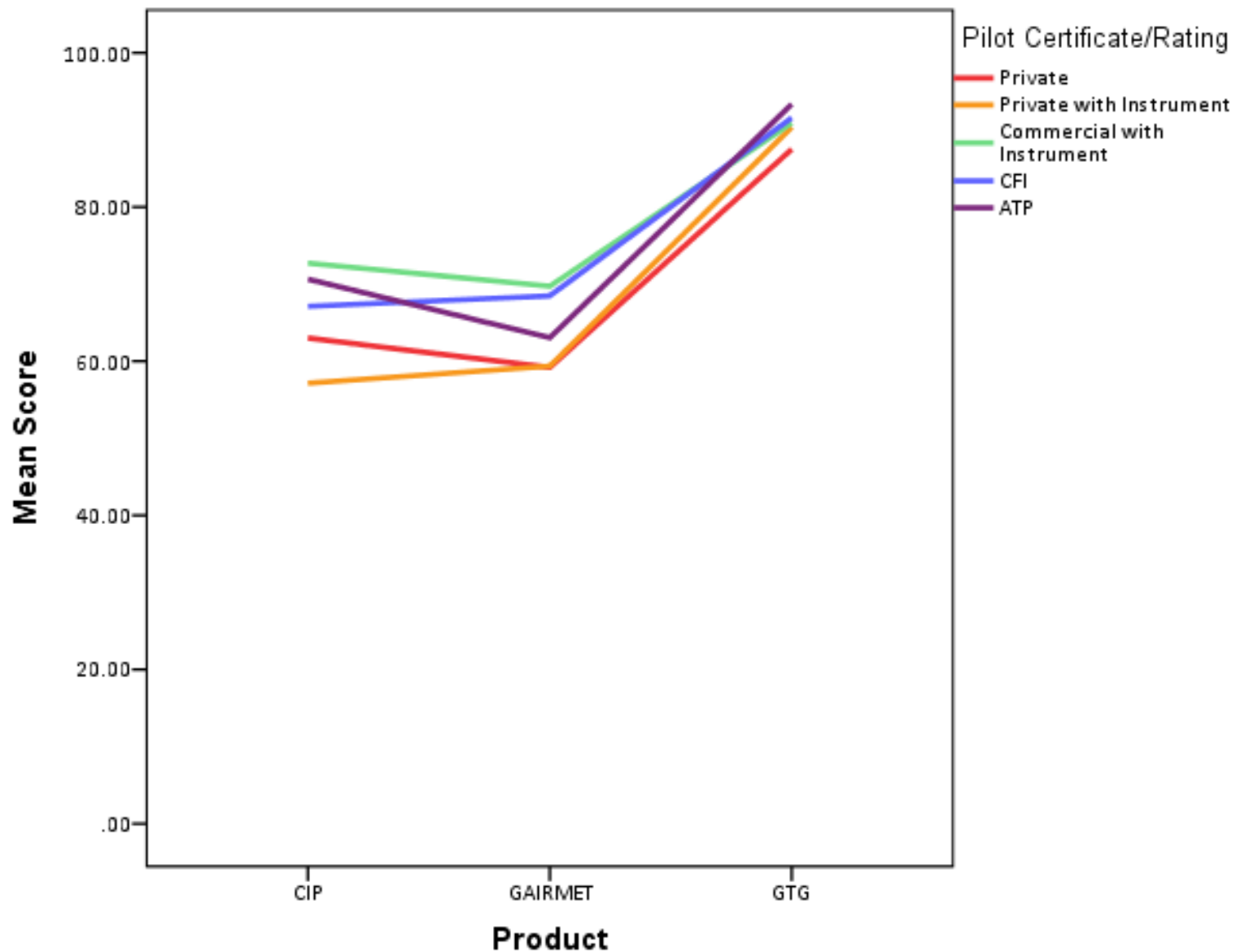Dependent variable: Percent Correct (Score)

Test 3

Significant main effect found of Product on Test 3 score,

Wilks' Lambda = 0.44, $F_{(2, 144)} = 90.8$, $p < 0.01$, partial

eta squared .56.

No significant main effect of Pilot Rating on Test 3 score,

$F_{(4, 145)} = 2.25$, $p = 0.59$, partial eta squared = 0.06

Test 3

No significant interaction of Product and Pilot Certificate/ Rating on Test 3 score,

Wilks' Lambda = 0.94, $F_{(8, 288)}$ = 1.09, p = .37, partial eta squared = 0.03
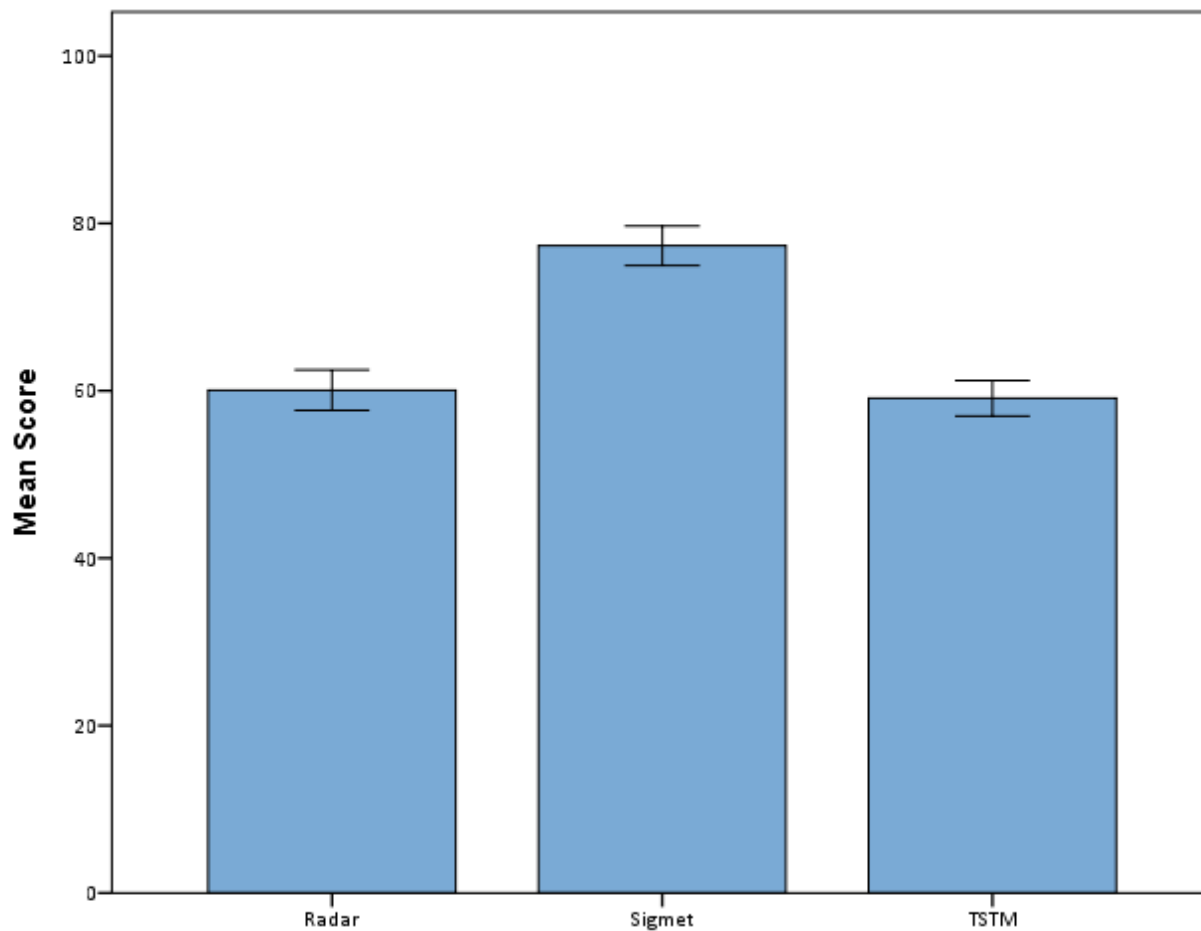
Test 4 Analysis

A 3x5 Mixed ANOVA

Independent Variable 1: Topics within Test 4
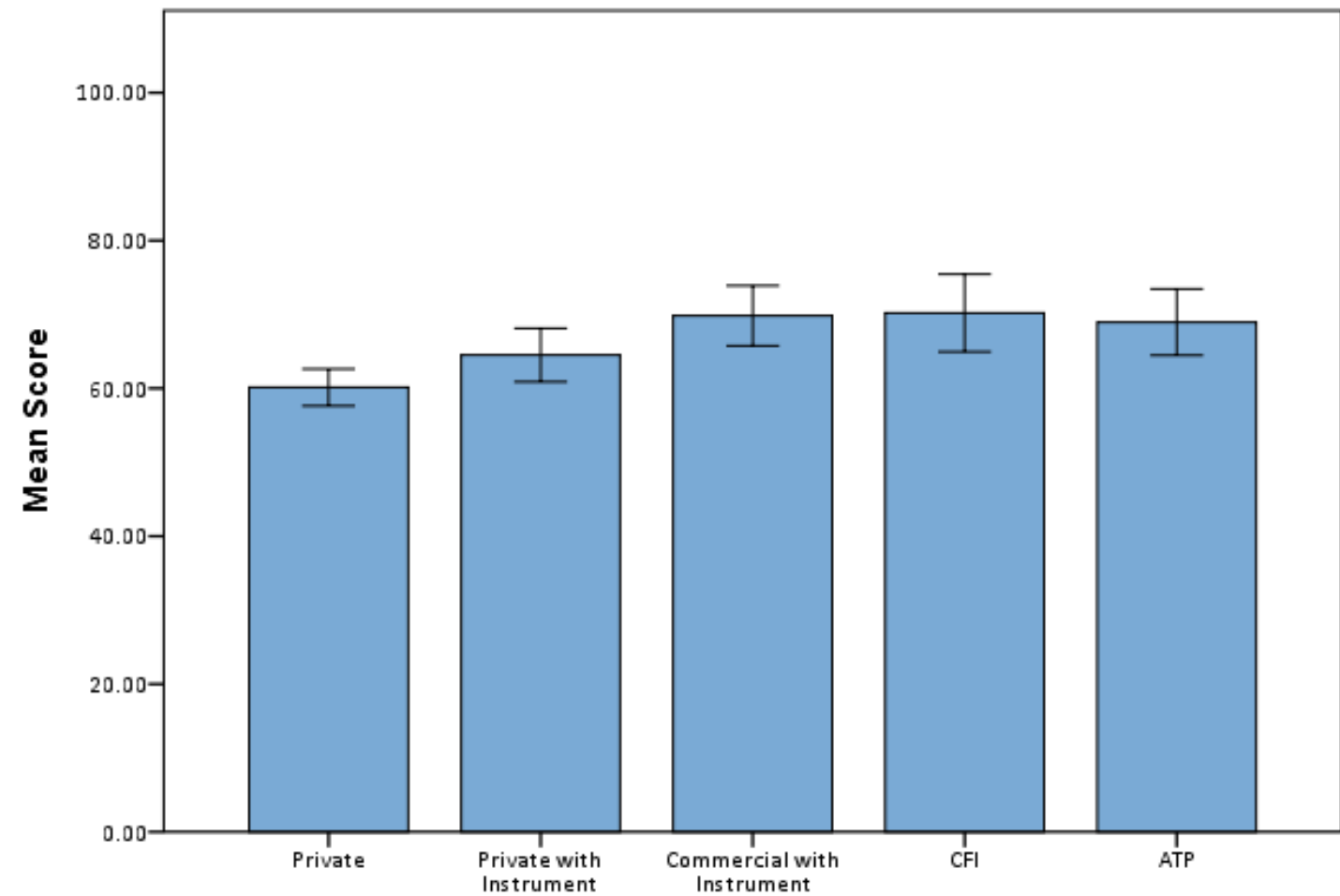   (Radar vs. SIGMET vs. Thunderstorm)

Independent Variable 2: Pilot Rating
    (Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

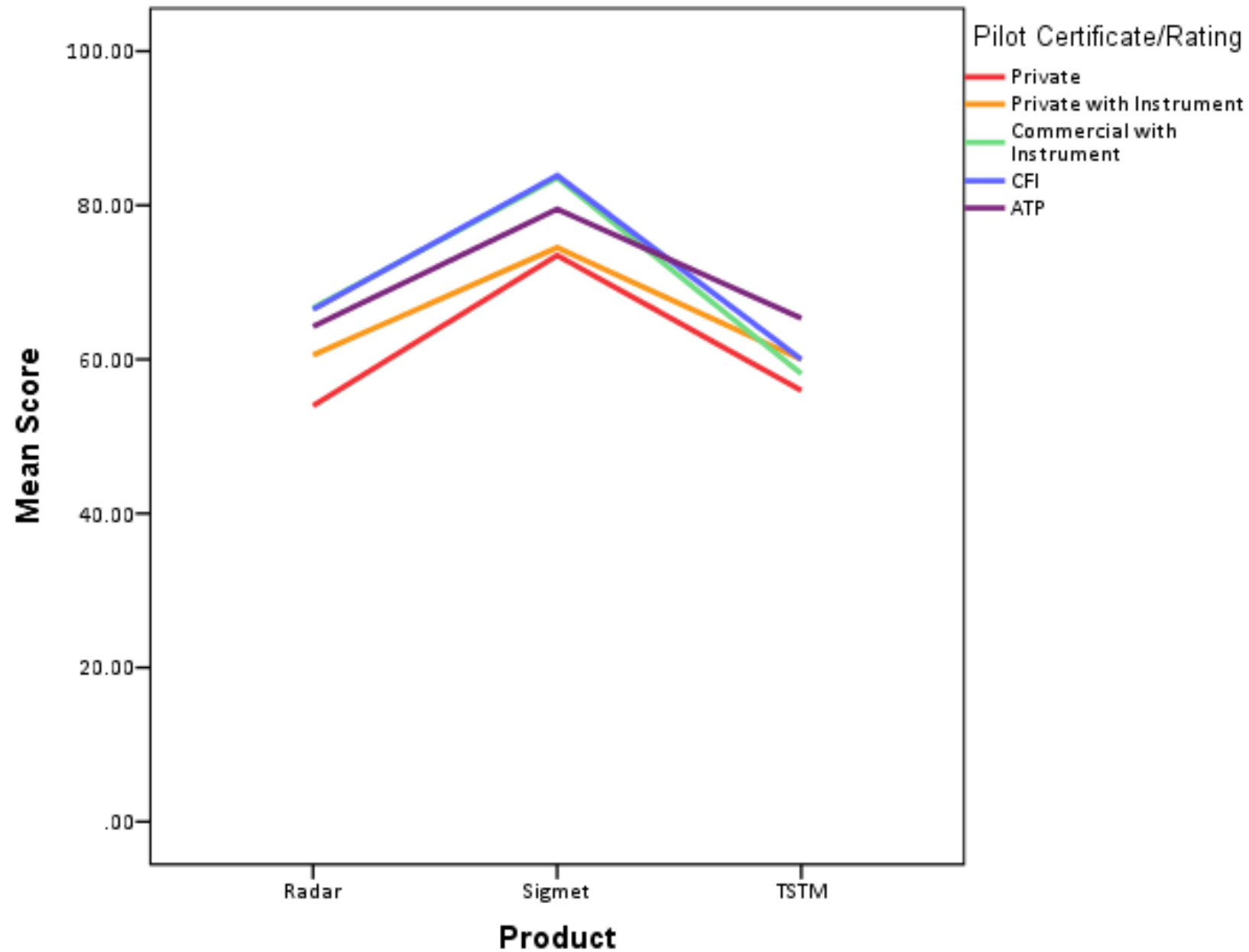Dependent variable: Percent Correct (Score)

Test 4

There was a significant effect for product on score,

Wilks' Lambda = 0.54, $F(2, 192) = 67.69$, $p < 0.01$, partial

eta squared = 0.46.

A significant main effect also occurred for Pilot

Certificate/Rating on score, $F(4, 193) = 6.16$, $p < 0.01$,

partial eta squared = 0.11.

Test 4

There was no significant interaction found between Product and Pilot Certificate/Rating,

Wilks' Lambda = 0.95, $F(8, 384) = 1.17$, $p = 0.32$, partial eta squared = 0.02
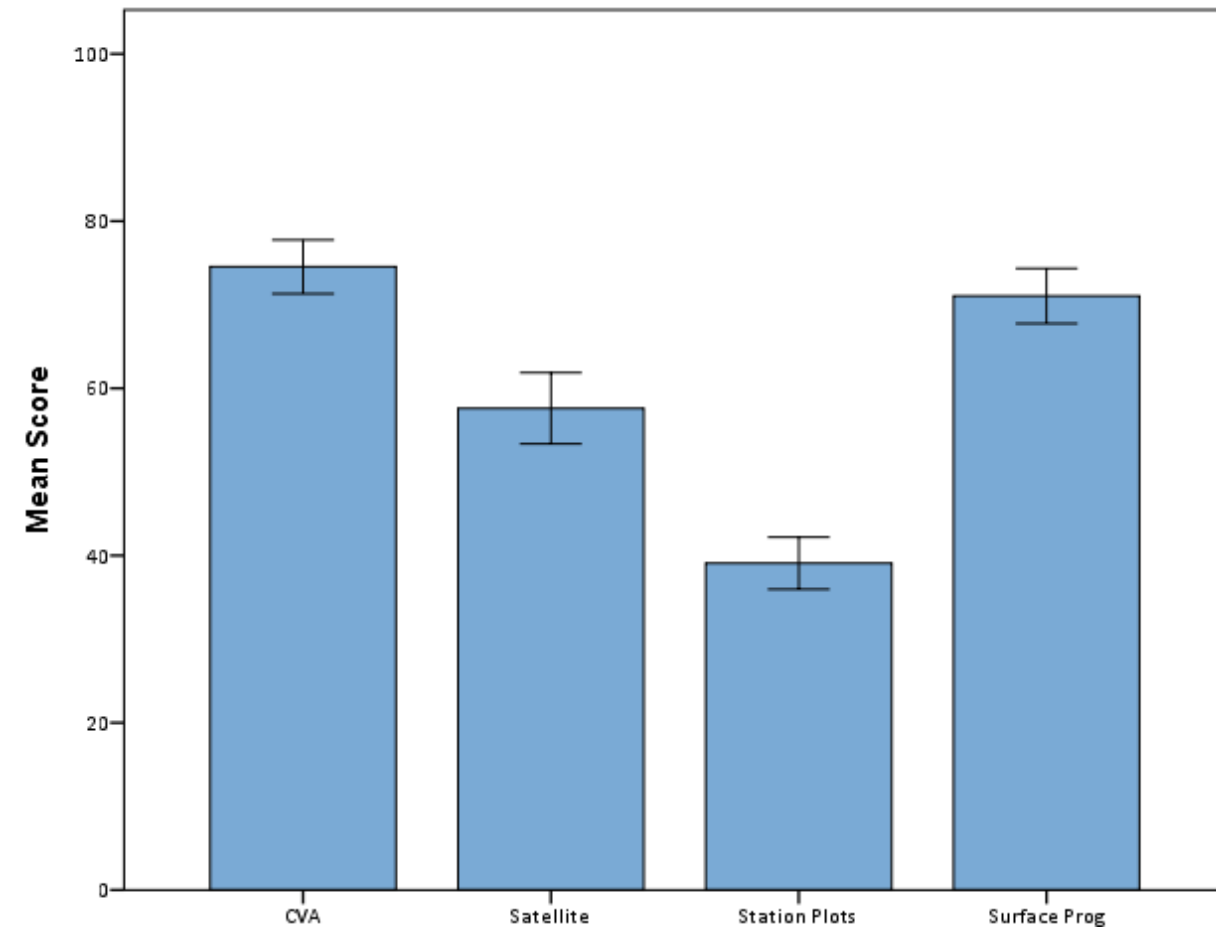
Test 5 Analysis

A 4x5 Mixed ANOVA

Independent Variable 1: Topics within Test 5
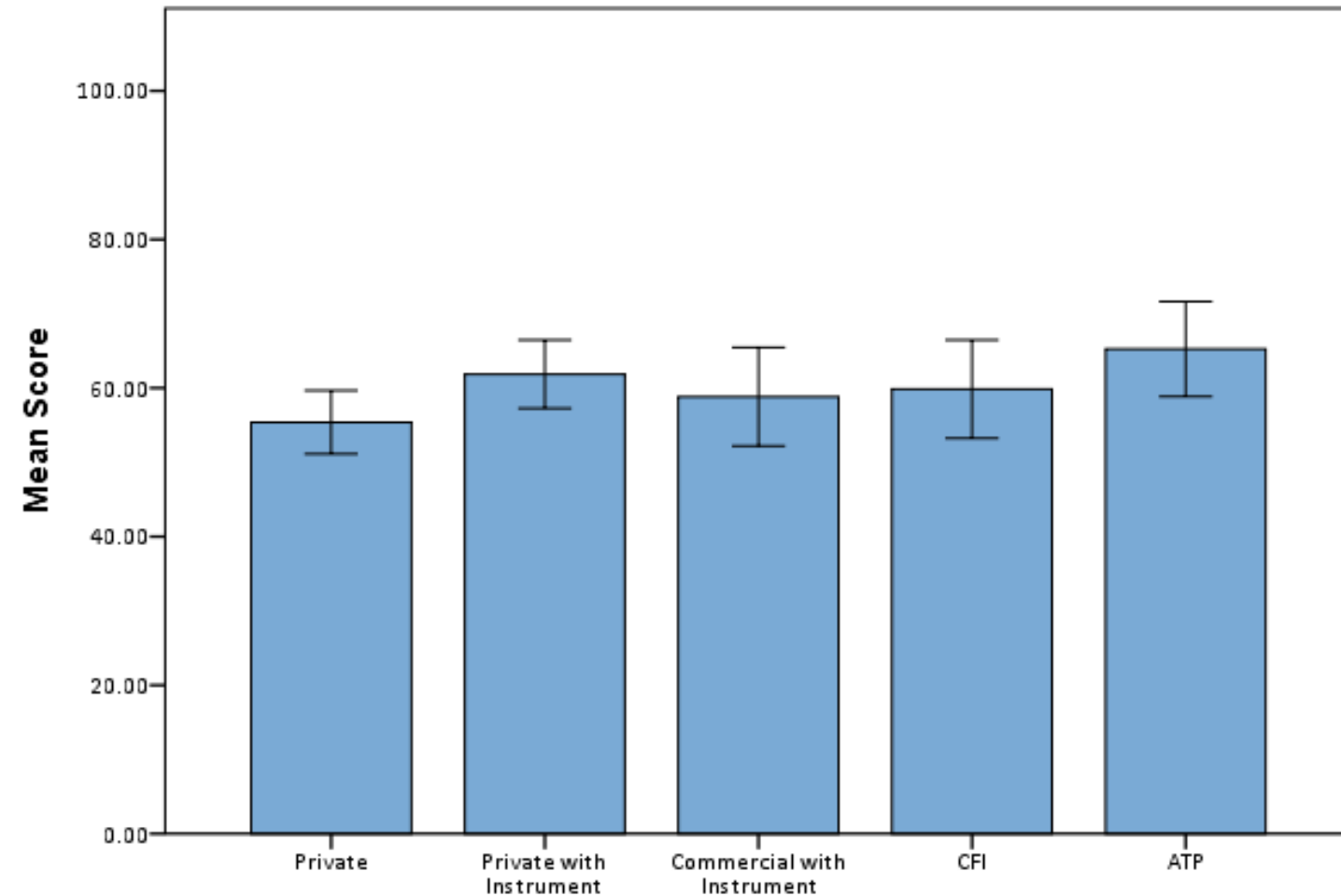   (CVA vs. Satellite vs. Station Plot vs. Surface Prognostic)

Independent Variable 2: Pilot Rating
   (Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

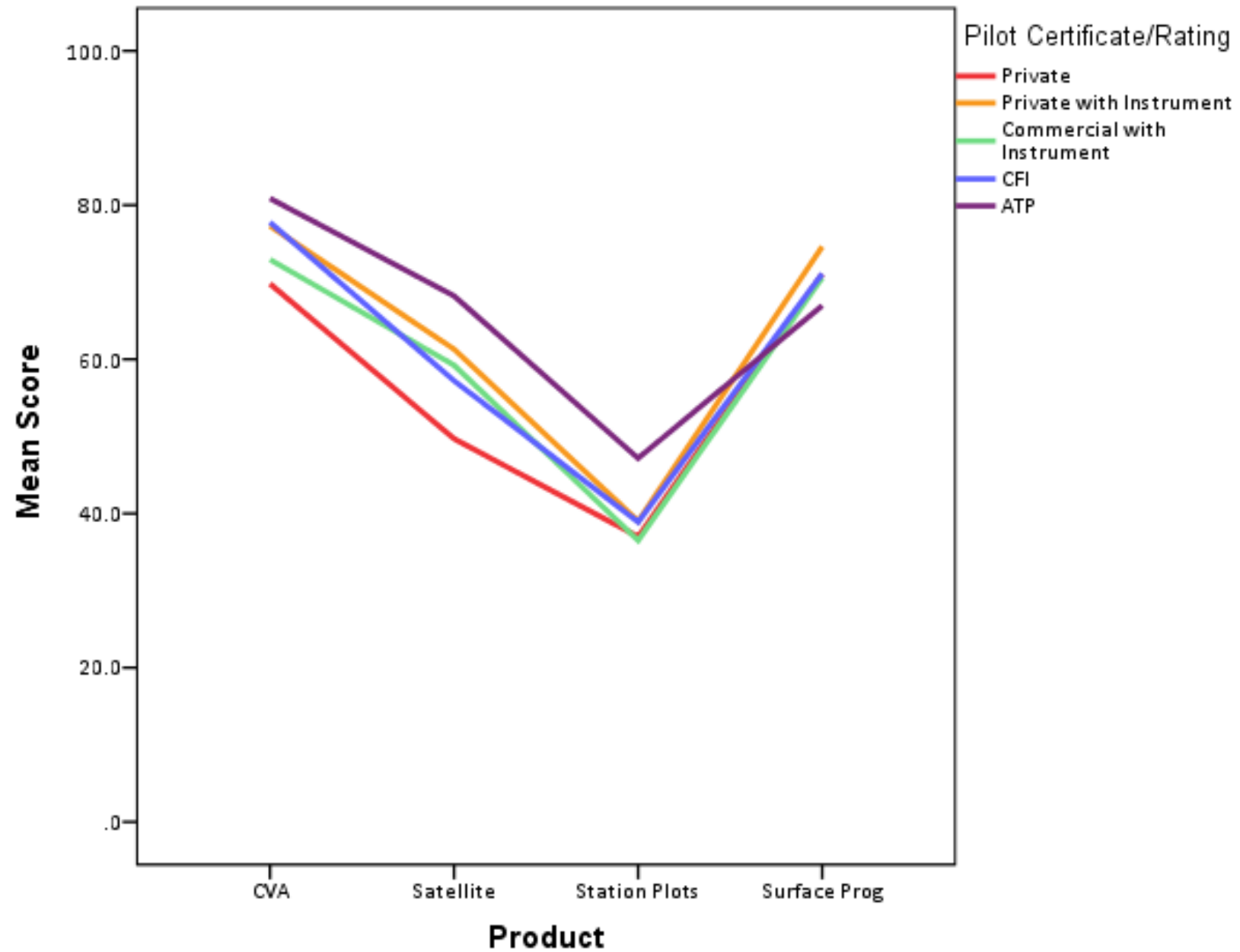Dependent variable: Percent Correct (Score)

Test 5

There was a significant main effect for product on score, Wilks' Lambda = 0.37, $F(3, 169) = 96.74$, $p < 0.01$, partial eta squared = 0.63.

There was no significant main effect of Pilot Certificate/Rating on score, $F(4, 171) = 0.21$, $p = 0.16$, partial eta squared = 0.04.

Test 5

There was no significant interaction between Pilot Certificate/ Rating and Product on

Score, Wilks' Lambda= 0.93, $F(12, 447.4) = .996$, $p = 0.45$, partial eta squared = 0.02.

Key Takeaways

➢ A major contributing factor in the weather accidents may be GA Pilots' inability to interpret weather displays.

➢ GA Pilots of ALL ratings and certificates are struggling on some products
  ➢ Radar, Satellite, Station Plots

➢ Good news:
  ➢ Better scores on GTG

➢ Further research is needed to understand why these gaps exist and how to fix them.
  ➢ Display design?
  ➢ Training?

Questions?