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

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

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October 17, 2018

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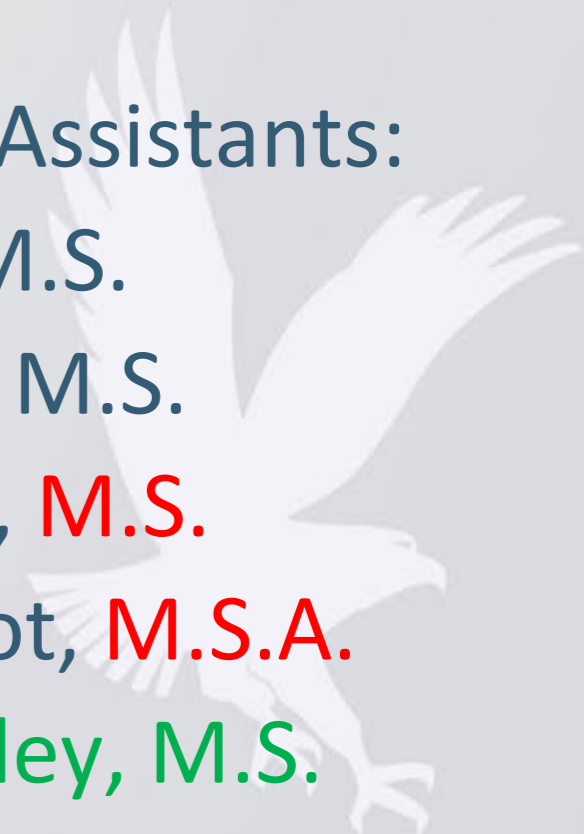
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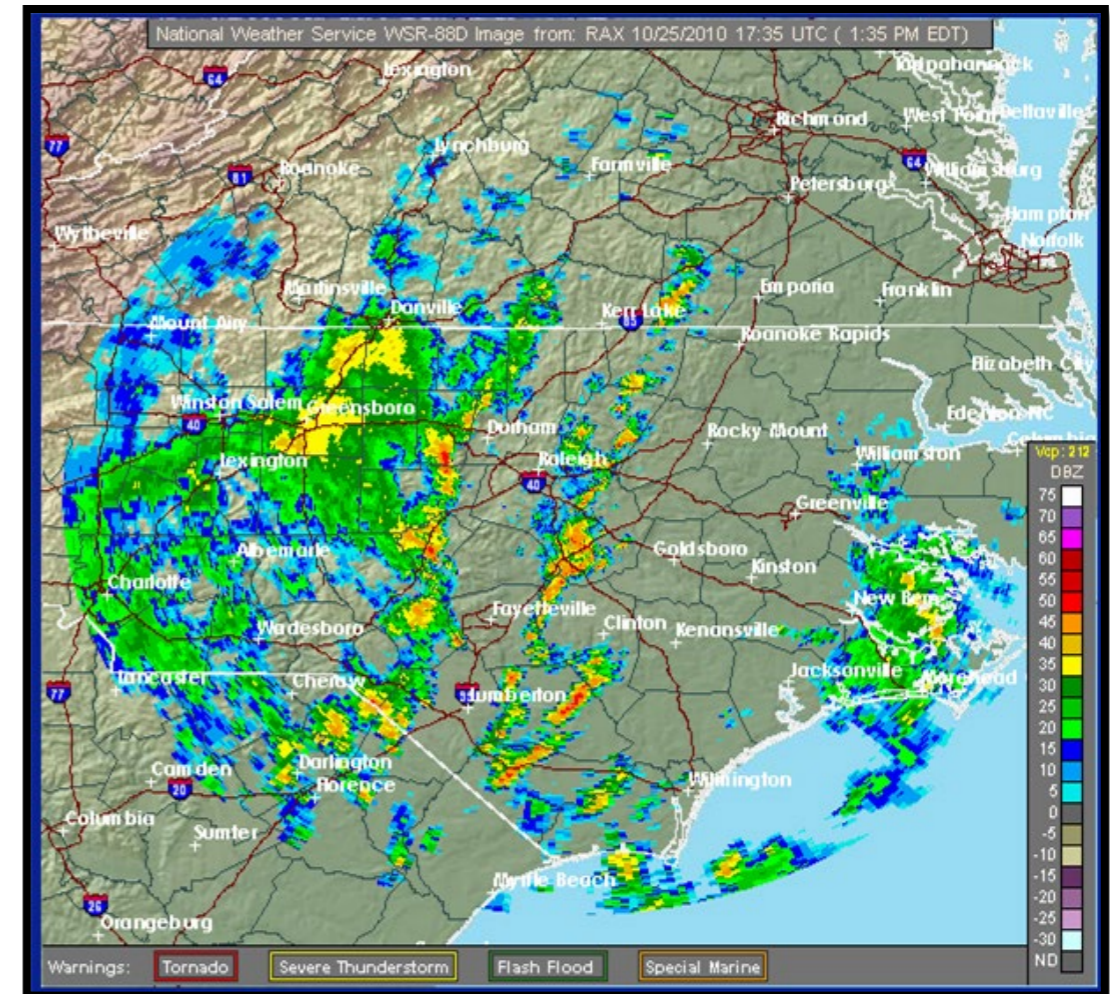


# Outline

- Background
- Method
- Results
- Discussion

## Acknowledgements:

- Funding for this project was provided by the FAA.
- Thank you to the Aircraft Owners and Pilots Association for their contribution to this study.



# 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”



# 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)

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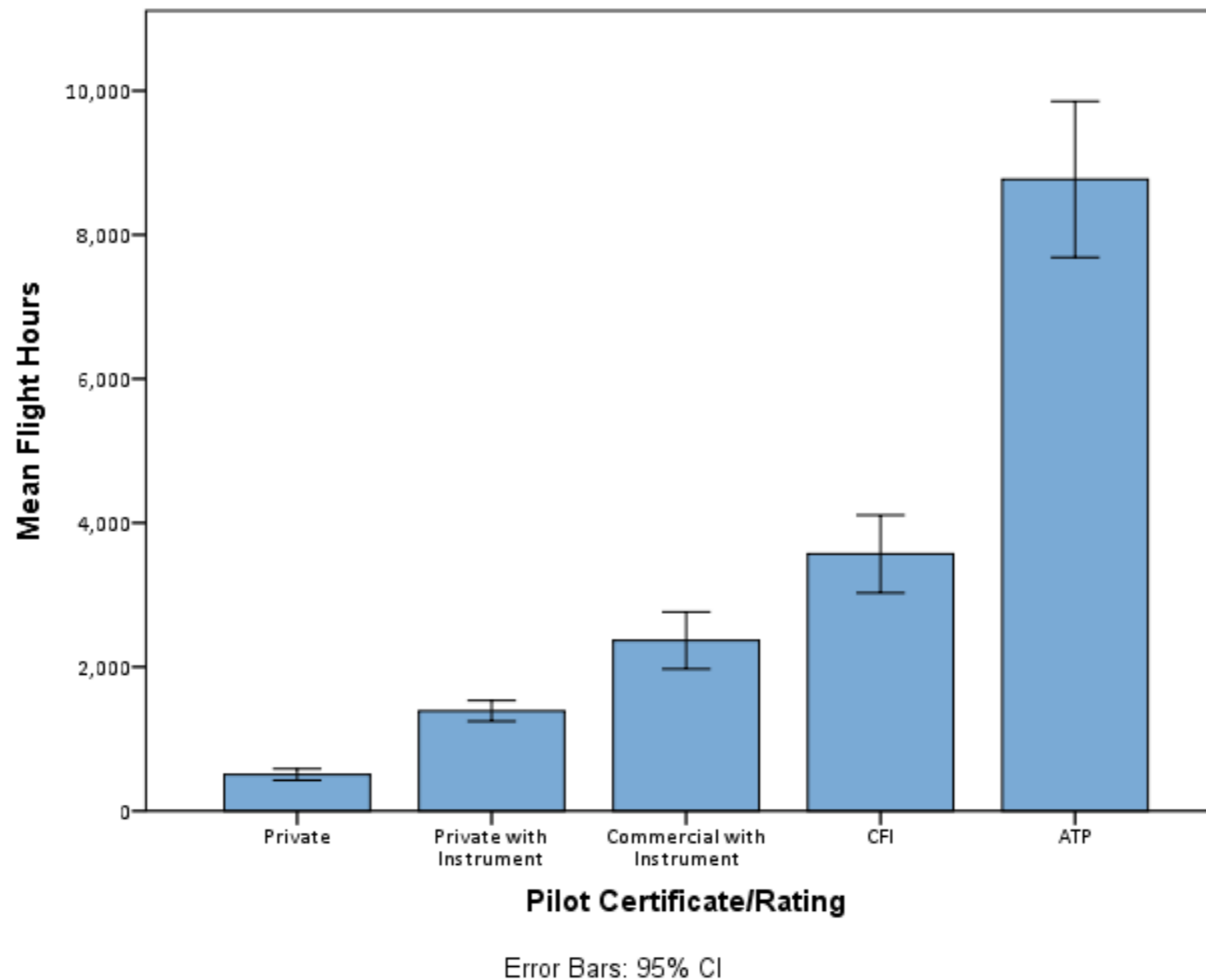
	Test 1	Test 2	Test 3	Test 4	Test 5	Total N
	n	n	n	n	n	
Private	69	35	40	55	49	<b>248</b>
Private w/ Instrument	41	47	55	46	51	<b>240</b>
Commercial w/ Instrument	39	22	11	29	33	<b>134</b>
ATP	22	24	24	7	23	<b>100</b>
CFI	35	21	19	22	18	<b>115</b>
Total	<b>206</b>	<b>149</b>	<b>149</b>	<b>159</b>	<b>174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

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# Locations

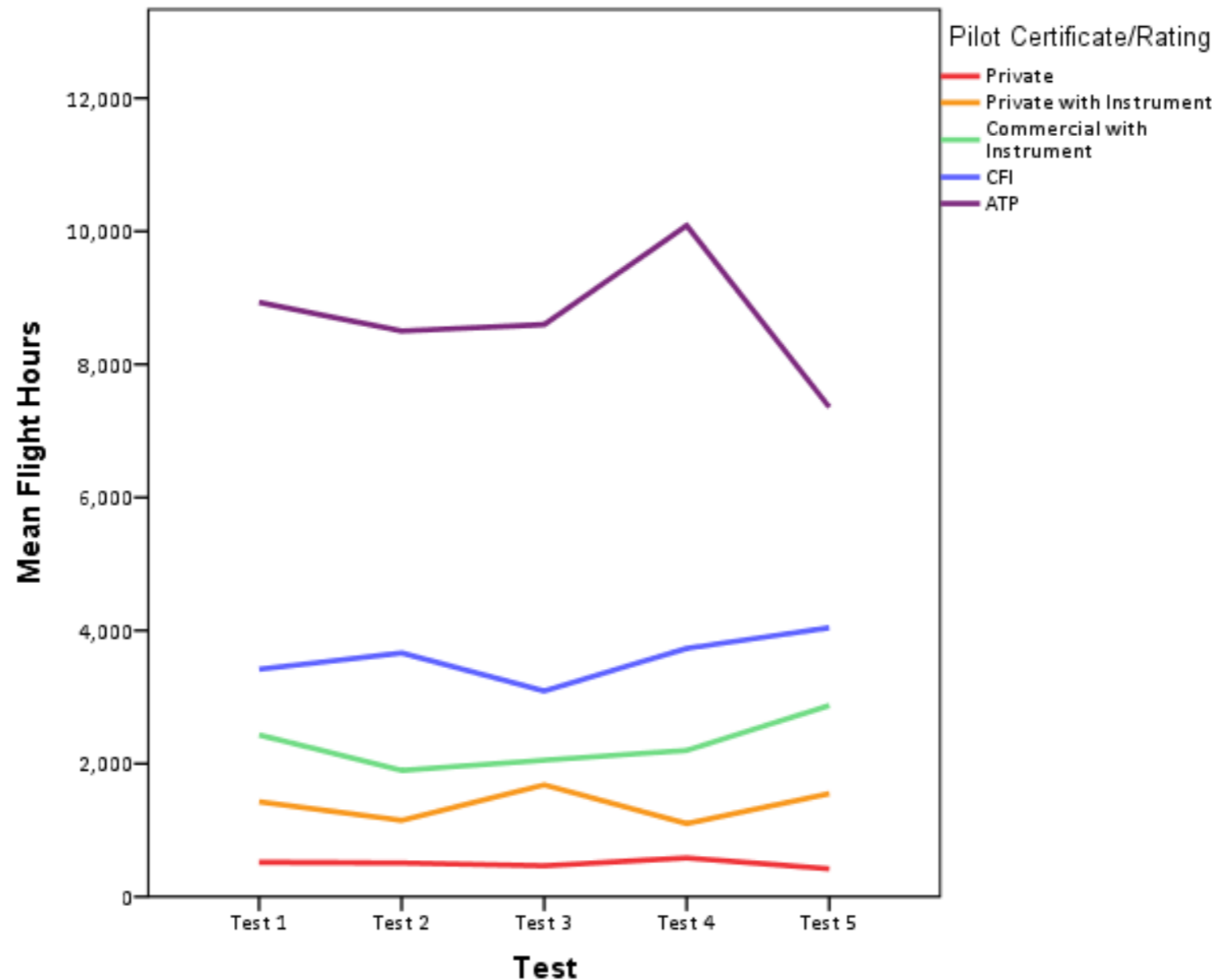


# Participant Mean Flight Hours



There was a significant main effect for rating on flight hours,  
 $F(4, 850) = 196.99, p < 0.01, \text{partial eta squared} = 0.48$

# Overall Flight Hours by Test



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



# Overall Analysis

A 5x5 Between Groups ANOVA

Independent Variable 1: Test

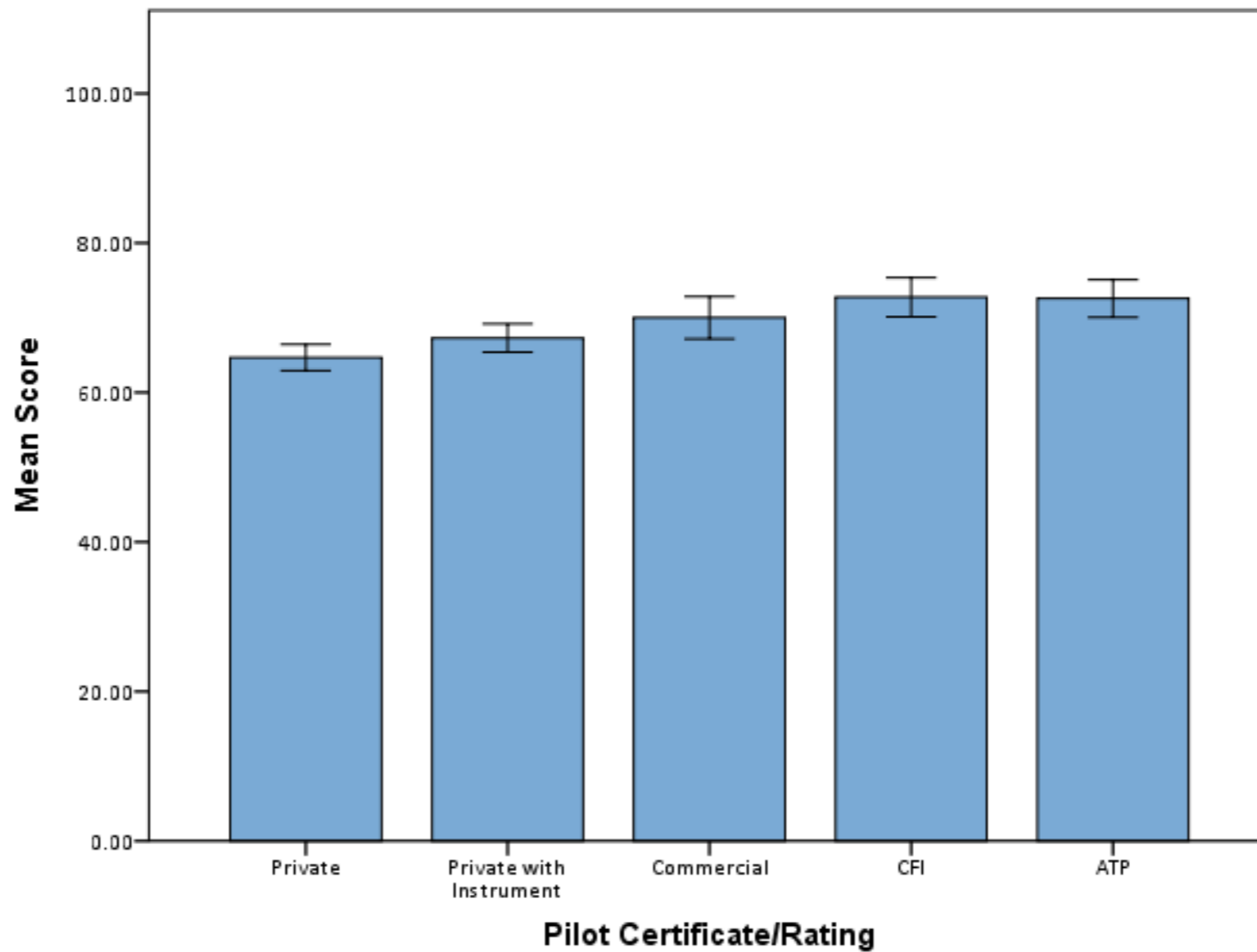
(Test 1 vs. Test 2 vs. Test 3 vs. Test 4 vs. Test 5)

Independent Variable 2: Pilot Rating

(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

Dependent variable: Percent Correct (Score)

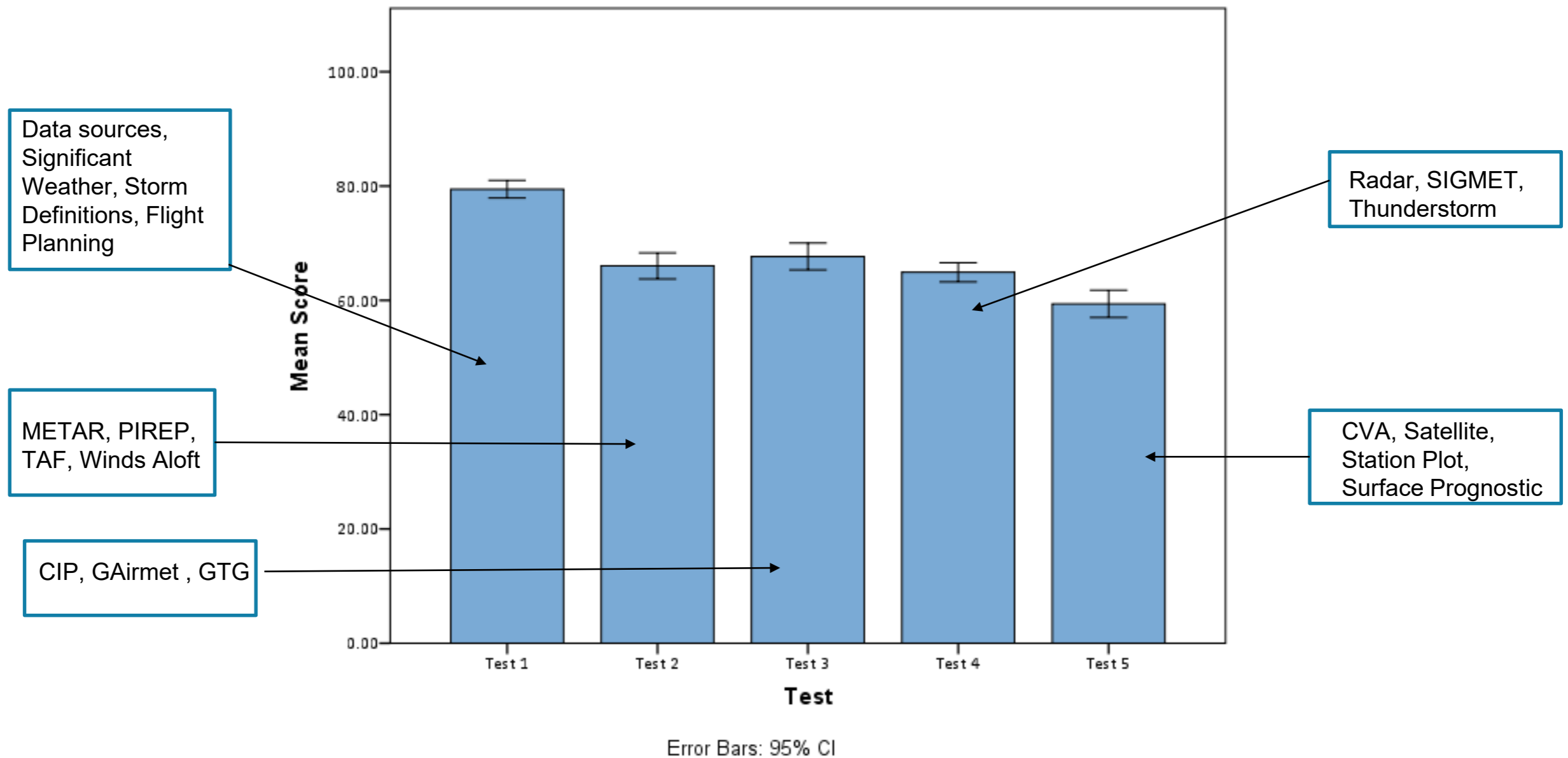
# Effect of Rating on Score



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.

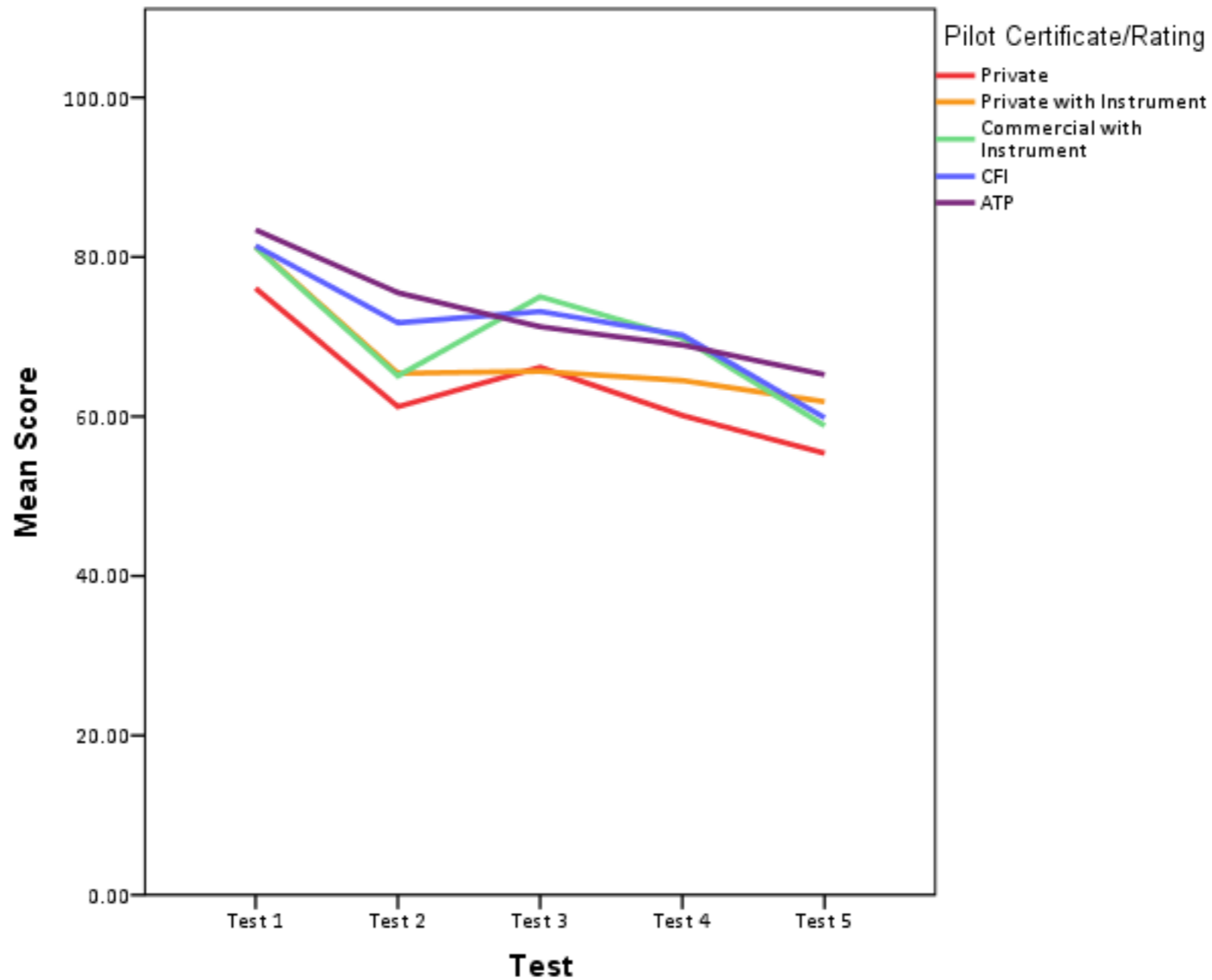
# Effect of Test on Score



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

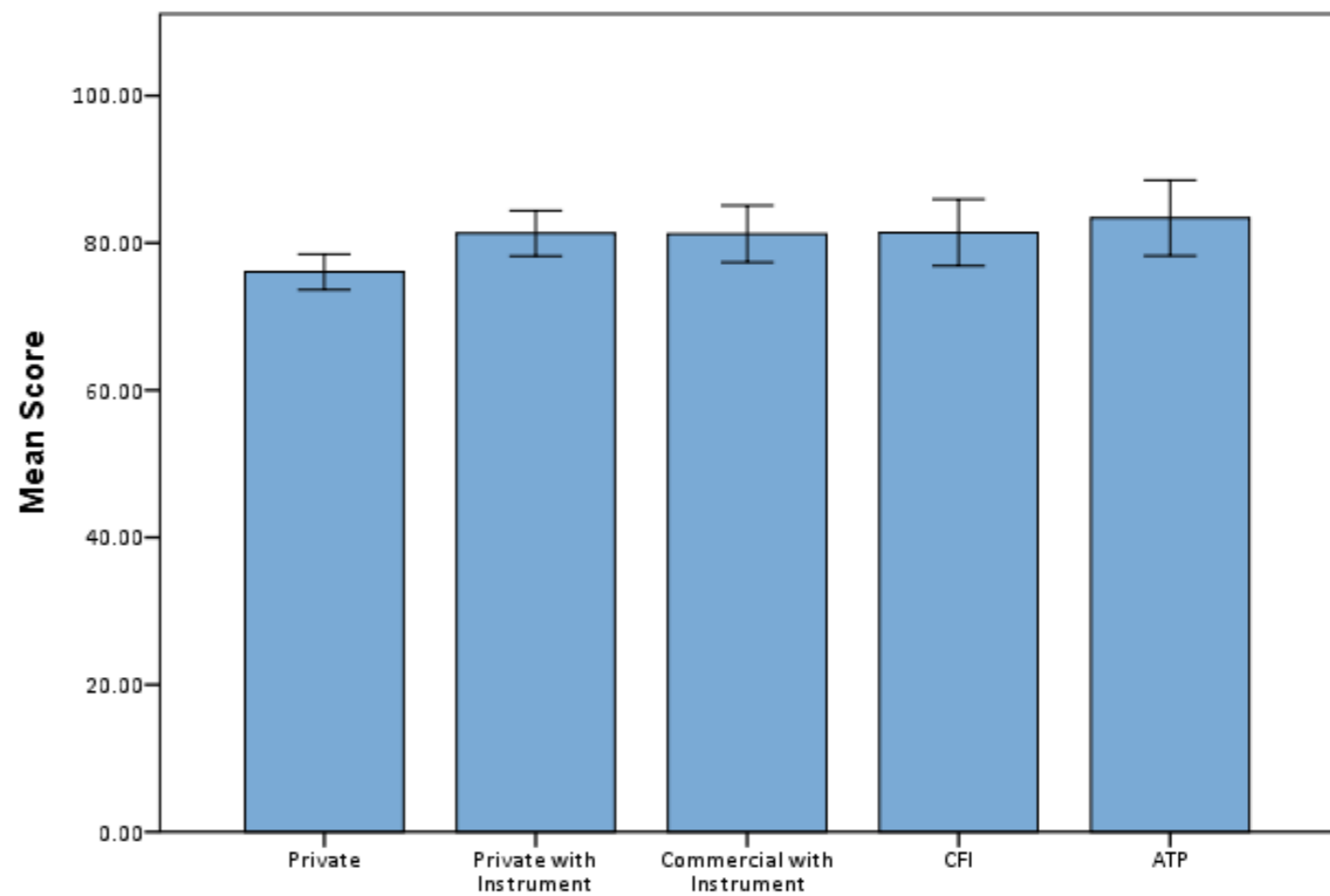
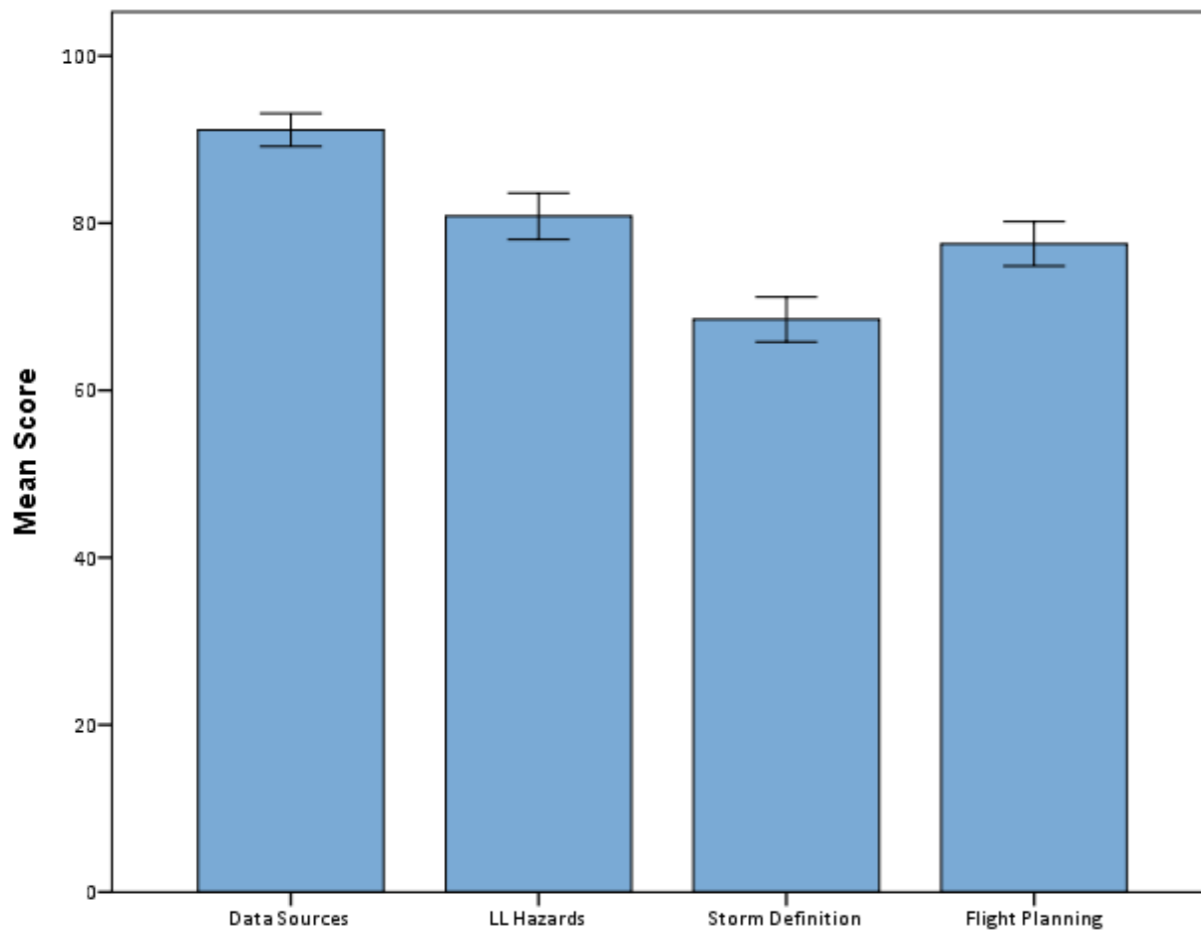
(Data sources vs. Significant Weather vs. Storm Definitions vs. Flight Planning)

Independent Variable 2: Pilot Rating

(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

Dependent variable: Percent Correct (Score)

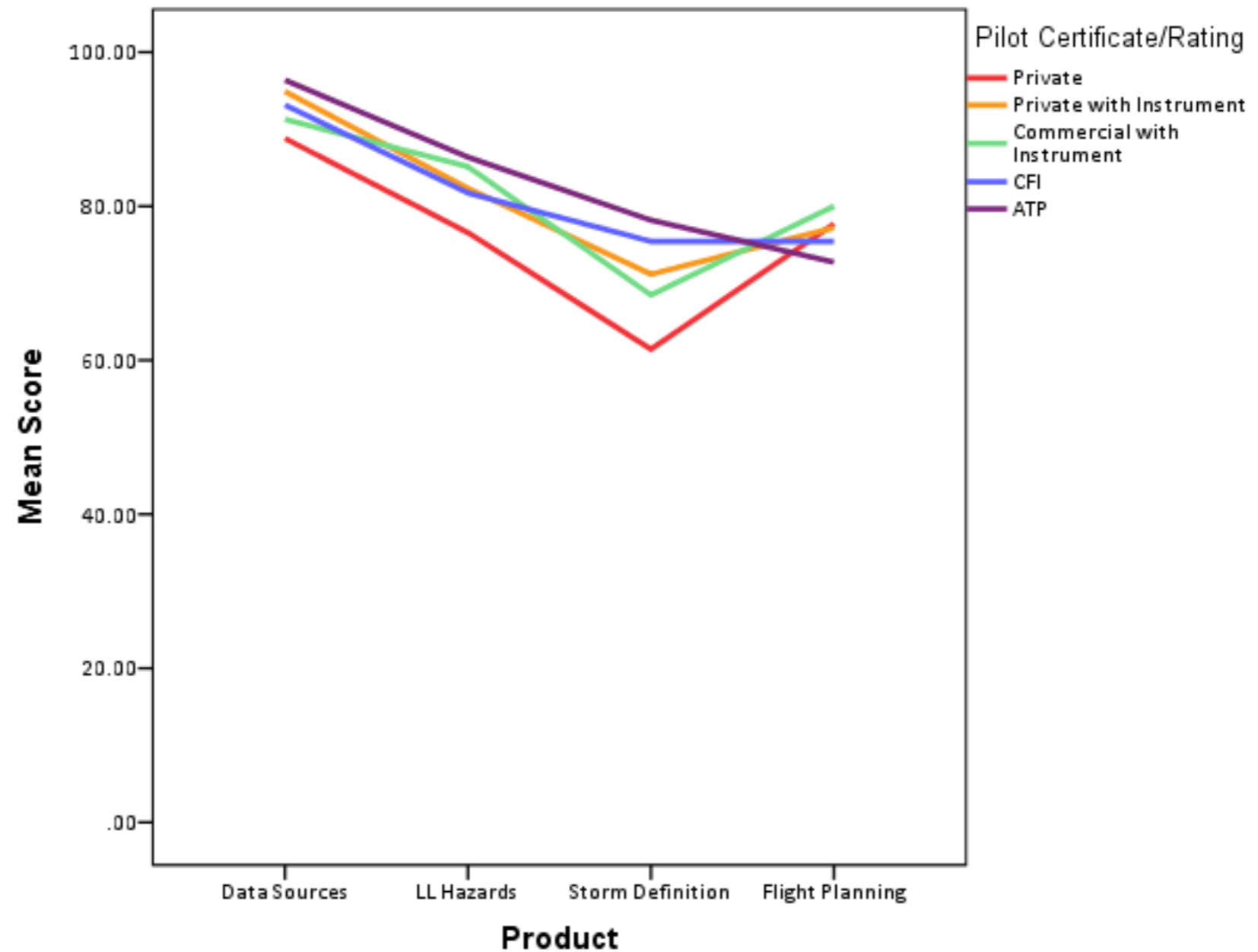
# Test 1



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

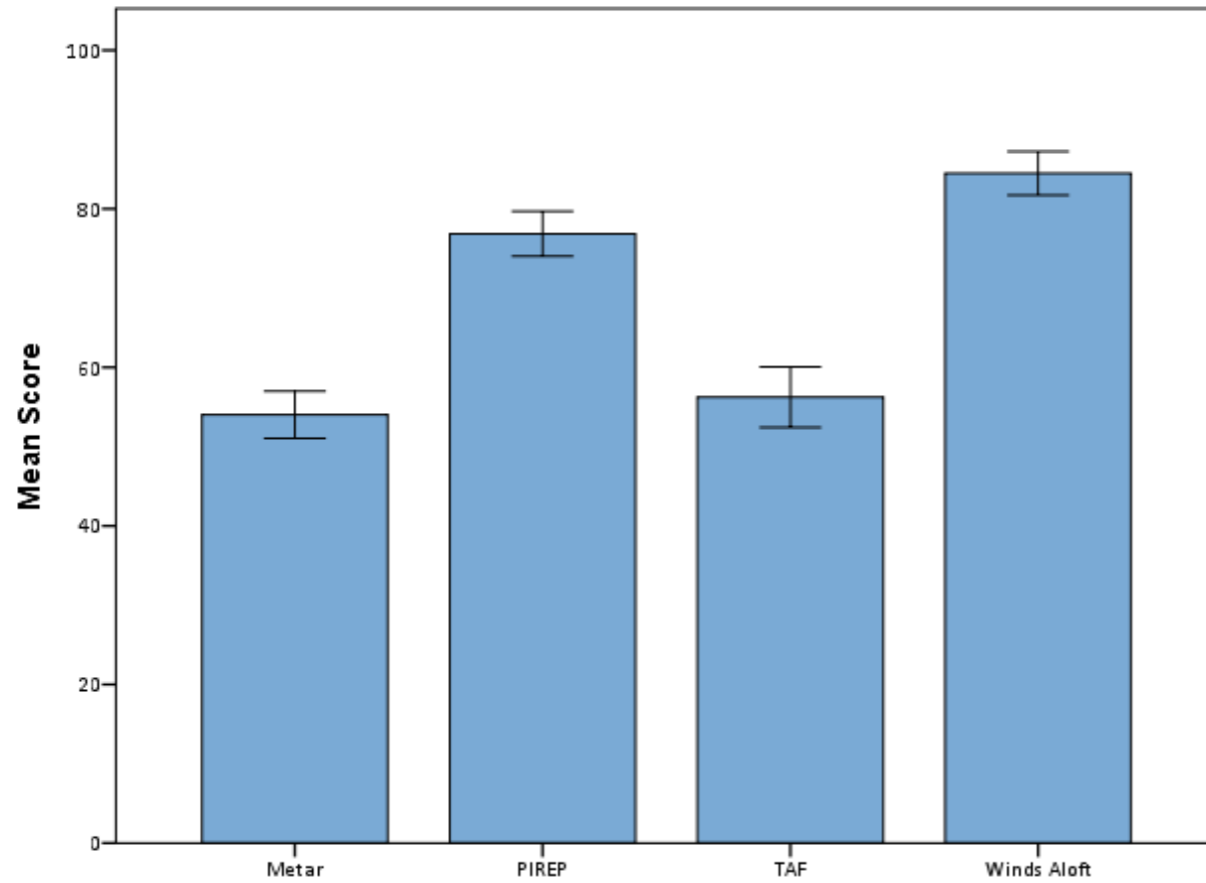
A 4x5 Mixed ANOVA

Independent Variable 1: Topics within Test 2  
(METAR vs. PIREP vs. TAF vs. Winds Aloft)

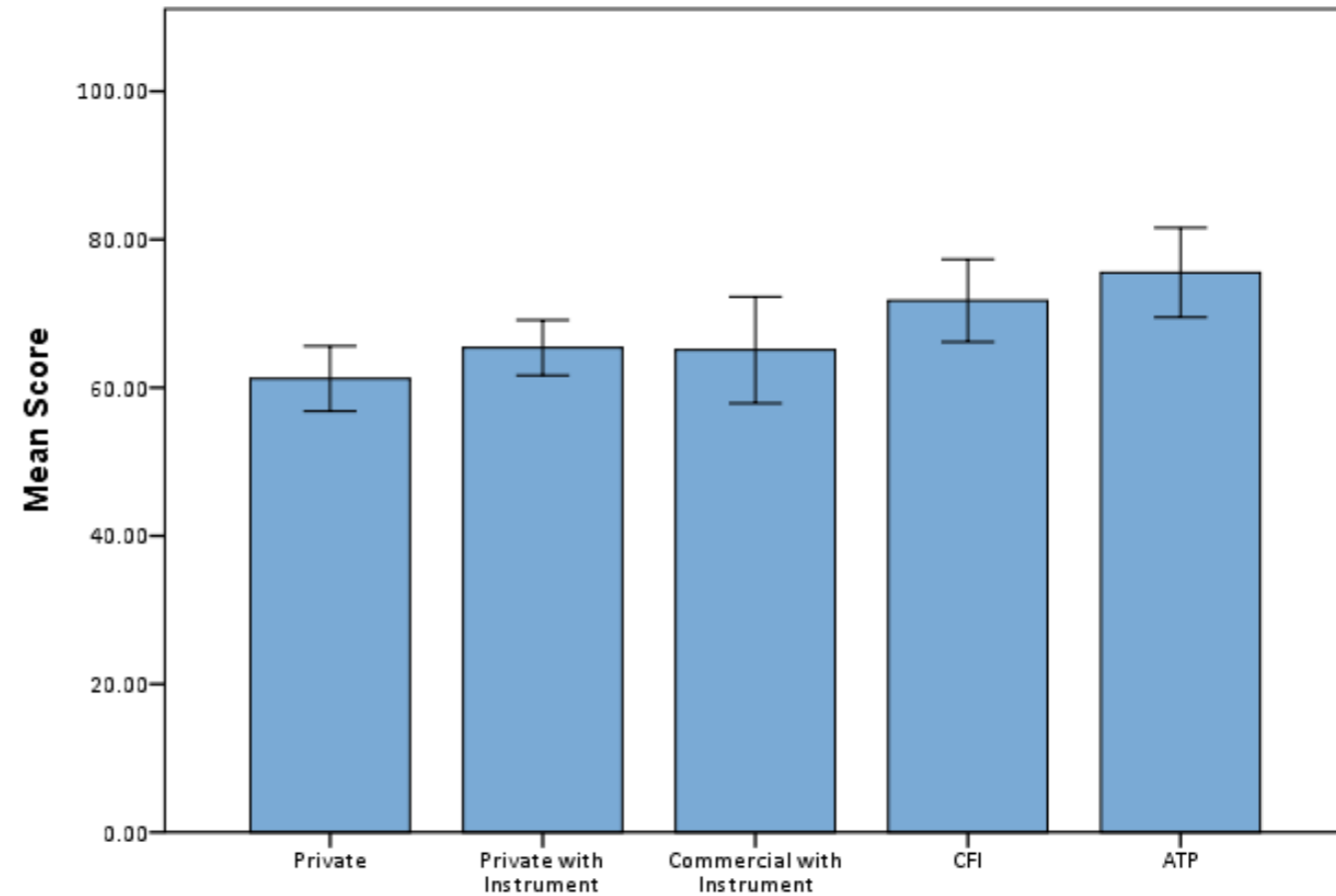
Independent Variable 2: Pilot Rating  
(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

Dependent variable: Percent Correct (Score)

# Test 2

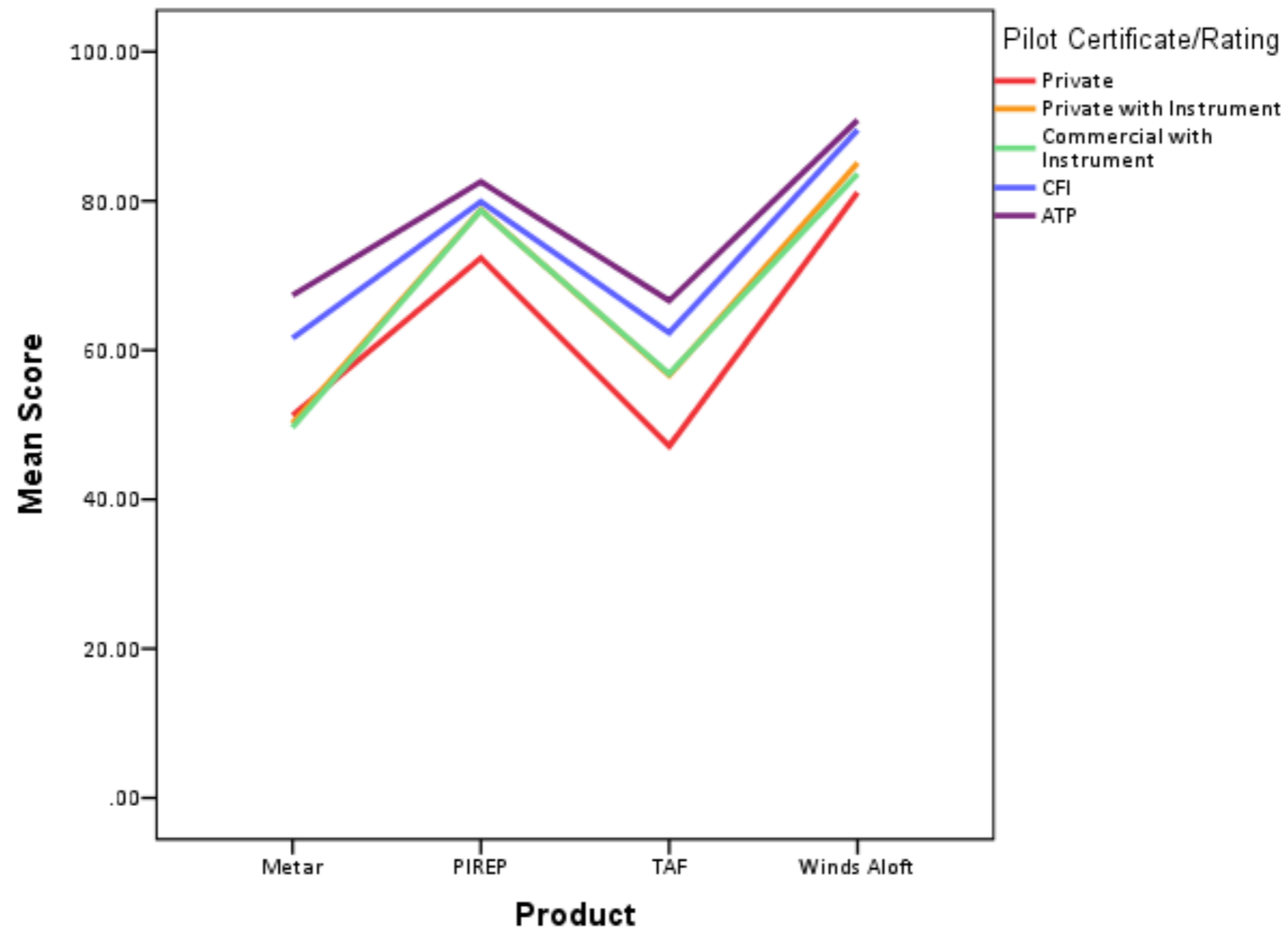


Significant main effect of product on Test 2 Score,  
Wilks' Lambda = .30,  $F(3, 142) = 110.63$ ,  $p < 0.01$ , partial eta squared = 0.70



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

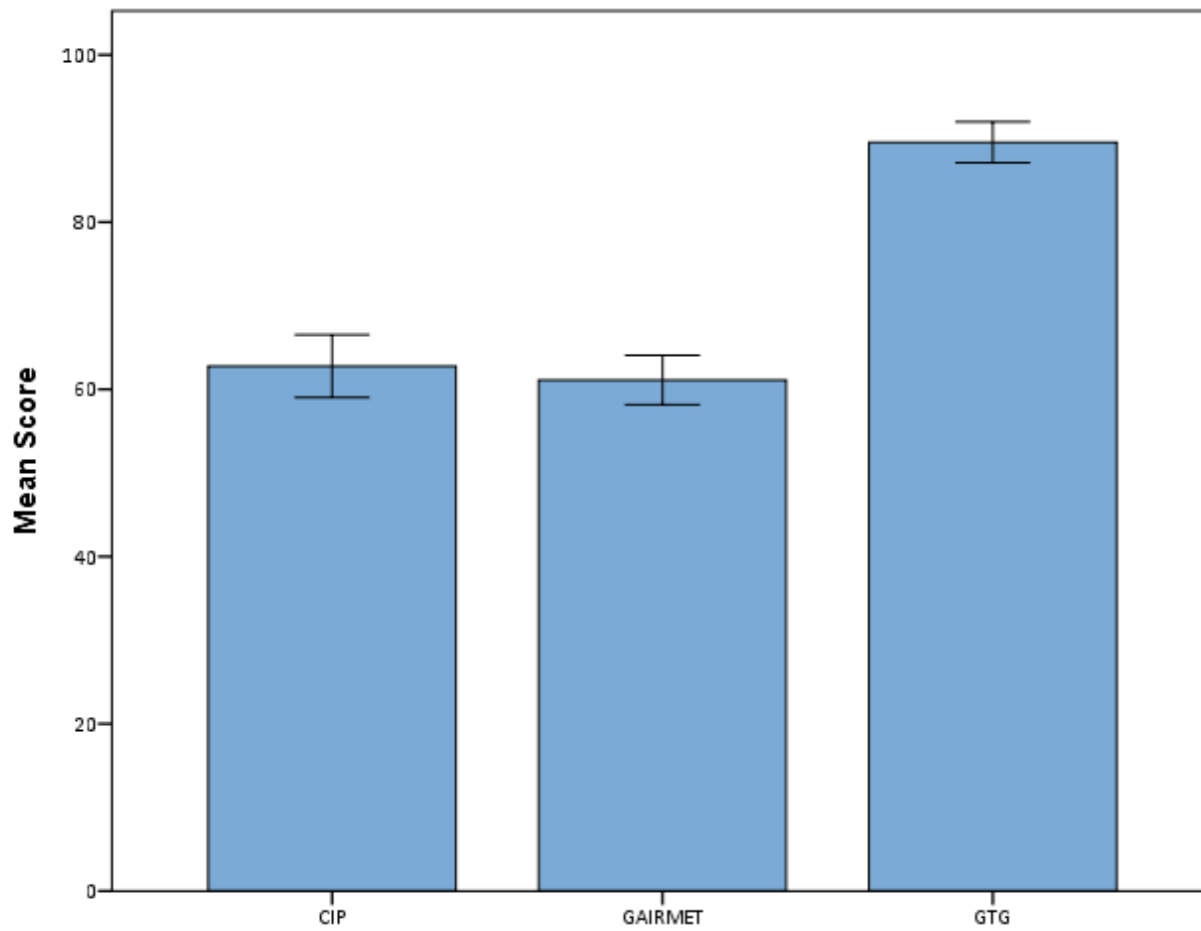
Independent Variable 1: Topics within Test 3  
(CIP vs. GAirmet vs. GTG)

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

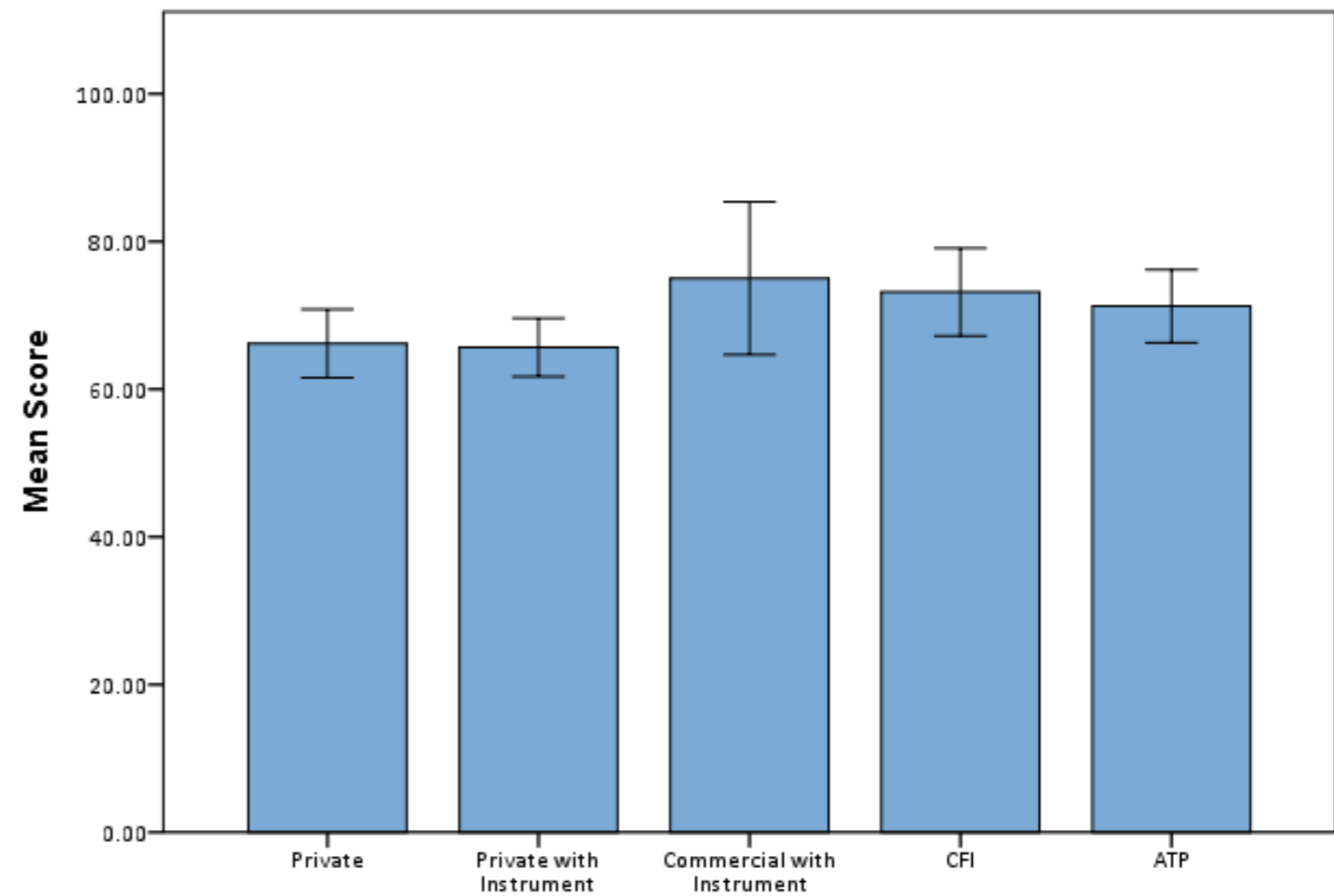
Dependent variable: Percent Correct (Score)



# Test 3

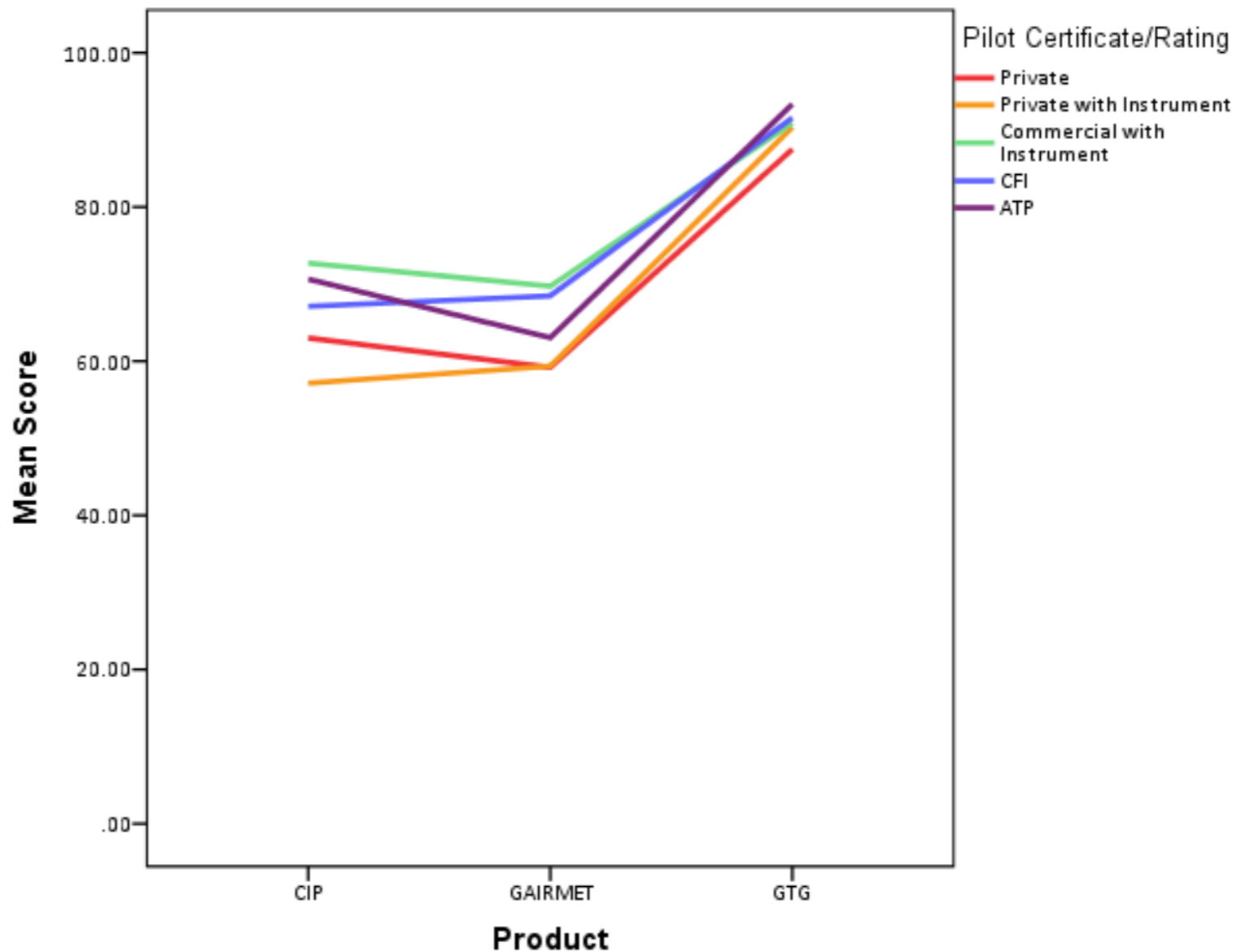


Significant main effect found of Product on Test 3 score,  
Wilks' Lambda = 0.44,  $F(2, 144) = 90.8$ ,  $p < 0.01$ , partial  
eta squared .56.



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

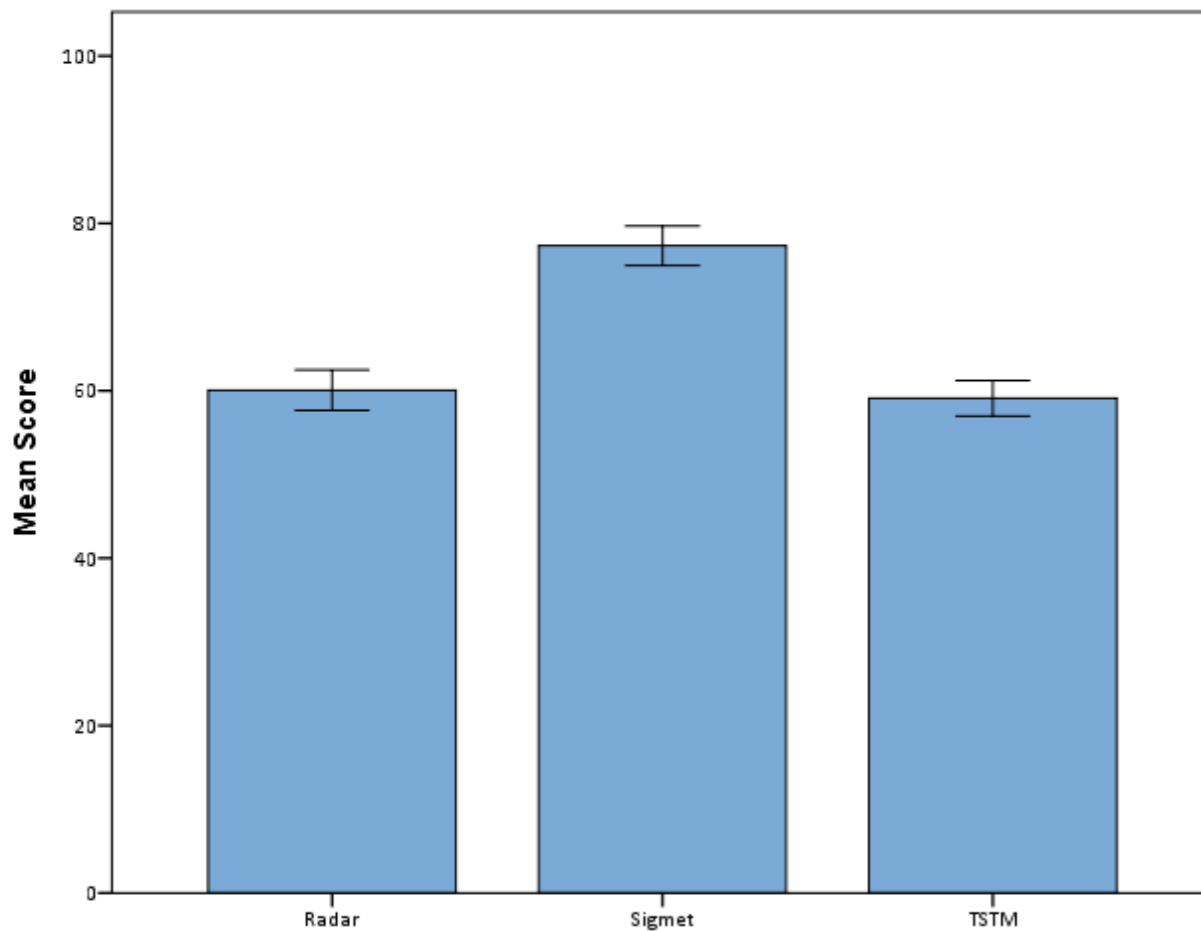
A 3x5 Mixed ANOVA

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

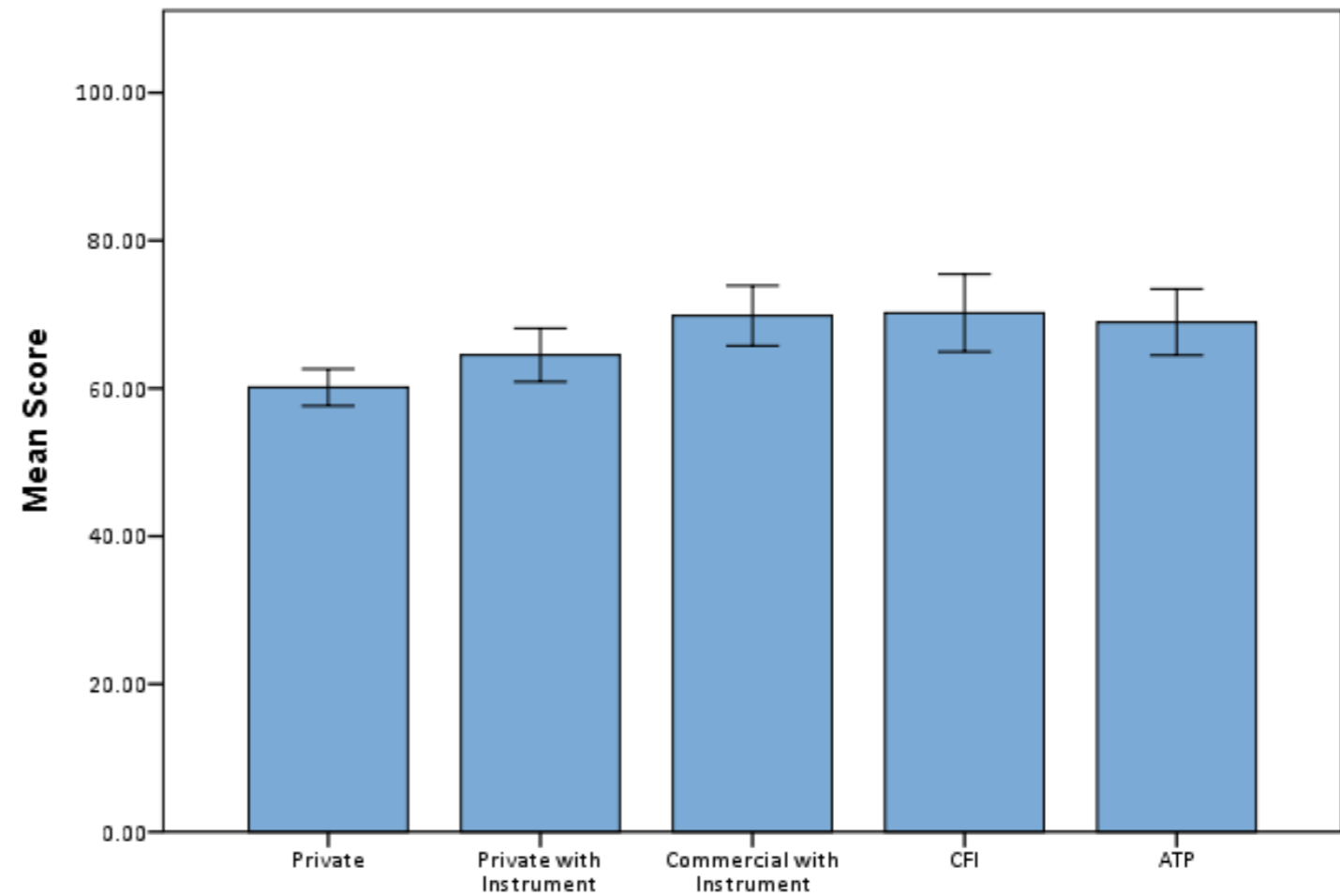
Independent Variable 2: Pilot Rating  
(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

Dependent variable: Percent Correct (Score)

# Test 4

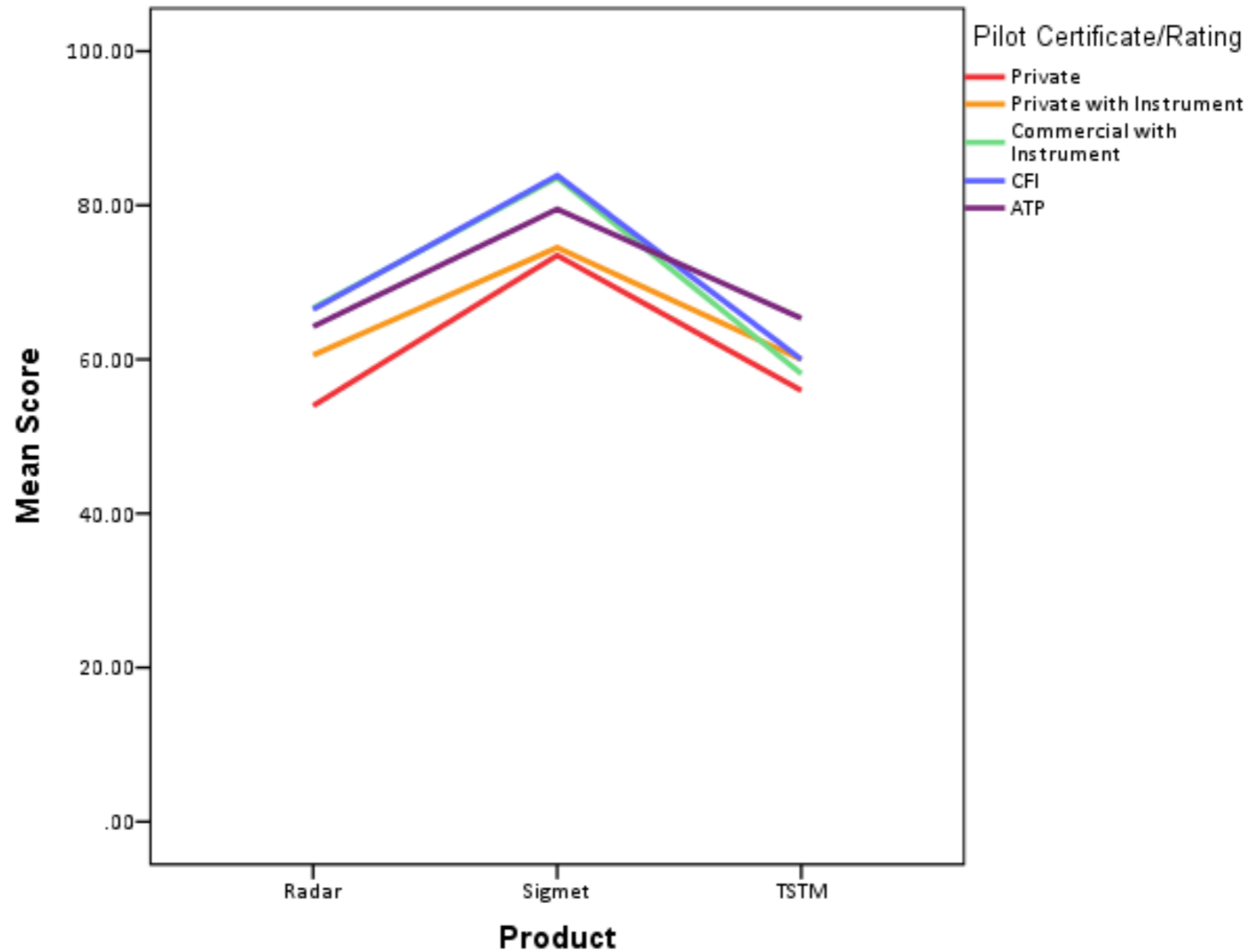


There was a significant effect for product on score, Wilks' Lambda = 0.54,  $F(2, 192) = 67.69$ ,  $p < 0.01$ , partial eta squared = 0.46.



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

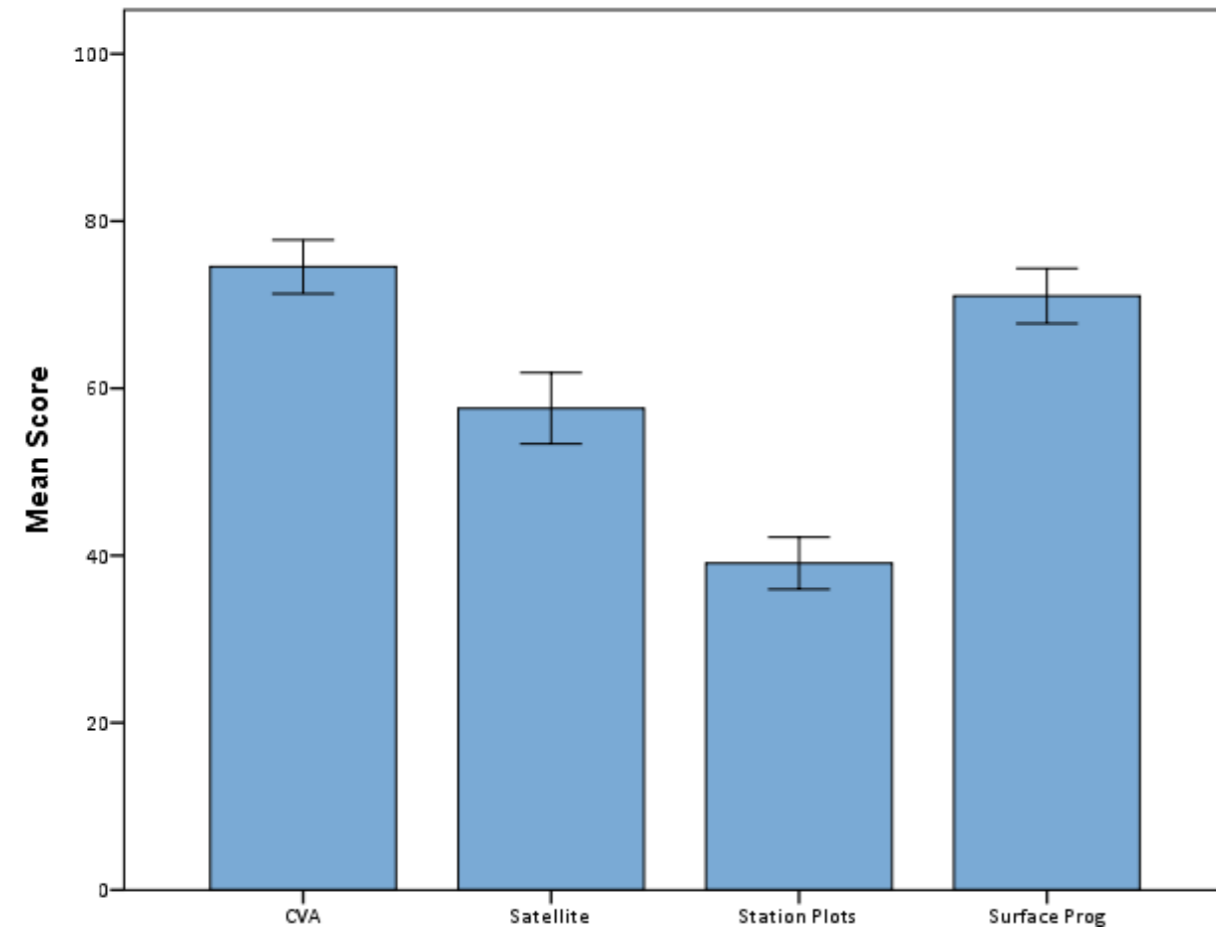
A 4x5 Mixed ANOVA

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

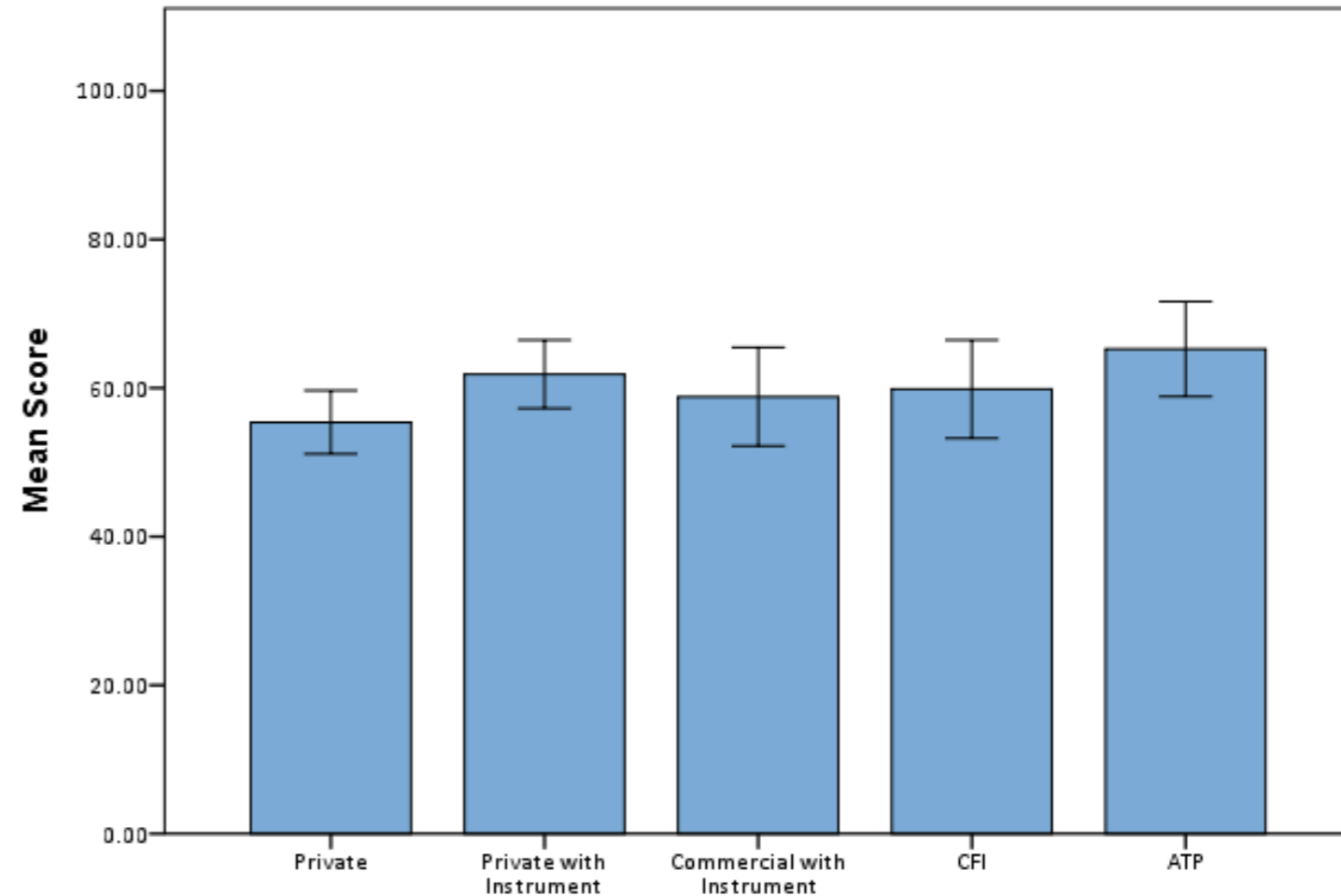
Independent Variable 2: Pilot Rating  
(Private vs. Private w/Inst vs. Commercial w/Inst vs. CFI vs. ATP)

Dependent variable: Percent Correct (Score)

# Test 5

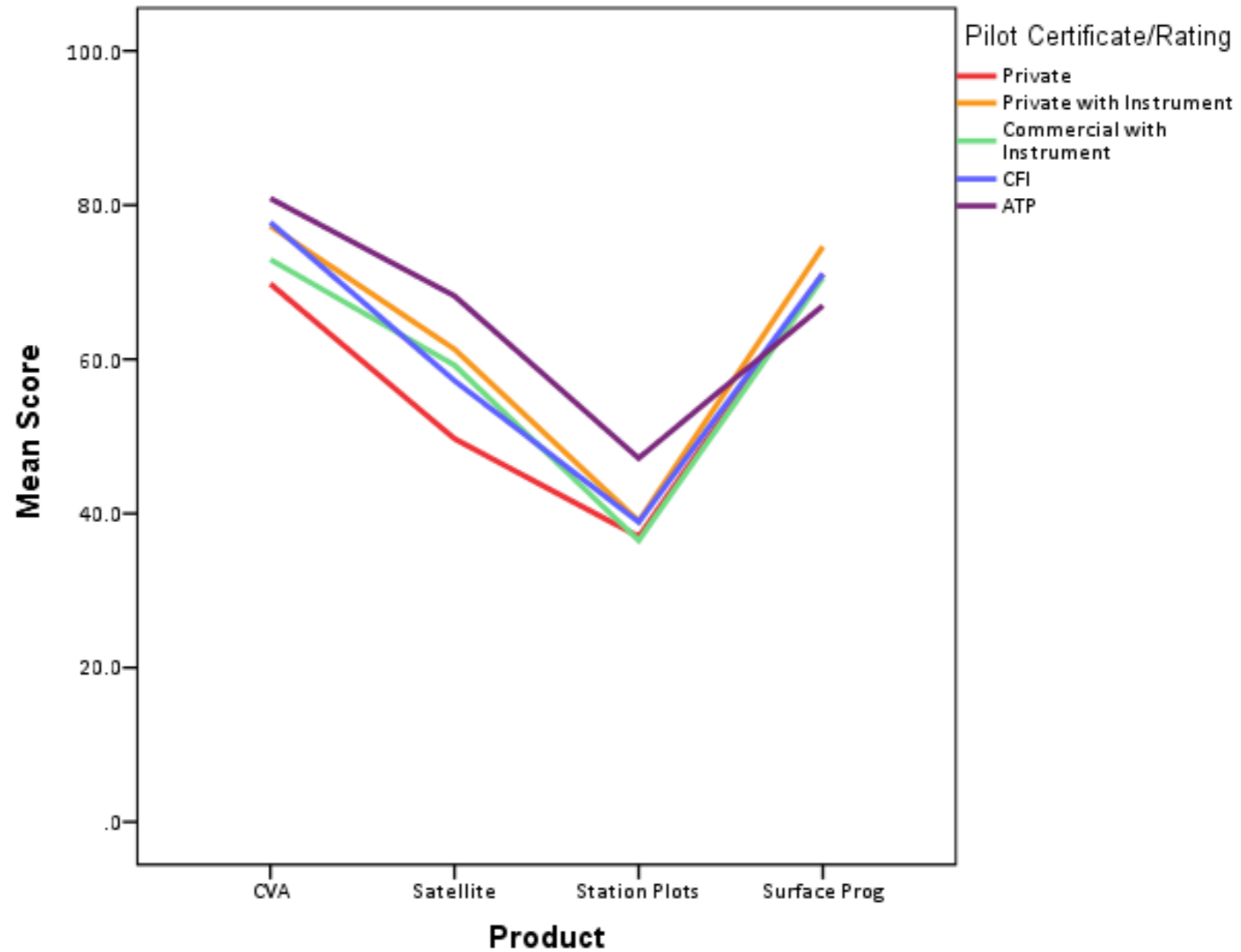


There was a significant main effect for product on score, Wilks' Lambda = 0.37,  $F(3, 169) = 96.74$ ,  $p < 0.01$ , partial eta squared = 0.63.



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?

