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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Outline

- Background
- Method
- Results
- Discussion

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- 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

\[ M(\text{SD}) = 57 \ (13.8) \]

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Test 5</th>
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<td>29</td>
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<td>24</td>
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<td>CFI</td>
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<td>21</td>
<td>19</td>
<td>22</td>
<td>18</td>
<td>115</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>149</strong></td>
<td><strong>149</strong></td>
<td><strong>159</strong></td>
<td><strong>174</strong></td>
<td><strong>837</strong></td>
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</table>
Locations
There was a significant main effect for rating on flight hours, \( F (4,850) = 196.99, p < 0.01, \) partial eta squared = 0.48
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

actual pilot deciding whether or not to fly in bad wx
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)
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.

Data sources, Significant Weather, Storm Definitions, Flight Planning

METAR, PIREP, TAF, Winds Aloft

CIP, GAirmet, GTG

Radar, SIGMET, Thunderstorm

CVA, Satellite, Station Plot, Surface Prognostic

There was a significant main effect of test on score:

\[ F (4, 857) = 53.39, \ p < 0.01 \]  
partial eta squared = 0.20.
The interaction was not significant, $F (16, 857) = 1.11$, $p = 0.338$, partial eta squared $= 0.02$. 

Interaction graph
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)
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
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)
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 $= 0.06$
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)
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.
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)
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.
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?