Assessing Aviation Weather Knowledge in General Aviation Pilots:
Overview and Initial Results

Beth Blickensderfer, Ph.D.
John Lanicci, Ph.D.
Thomas Guinn Ph.D.
Robert Thomas, M.S., ATP, CFII
Jayde King, M.S.
Yolanda Ortiz, M.S.

Presentation given at the Friends and Partners of Aviation Weather (FPAW) Meeting; Nov 2-3, 2016; Orlando, FL
Background

• Research indicates:
  ▫ FAA Knowledge exams for private and commercial pilots are out of date and too easy.
  ▫ GA Pilots may lack adequate aviation weather knowledge.
  ▫ Are knowledge gaps a contributing factor to accident rate?

• Aviation weather knowledge assessment tools:
  ▫ Practical use (e.g. FAA Exams → prompt better instruction)
  ▫ Research use (e.g. to identify aviation weather training needs; validate aviation weather training strategies)
Purpose

Develop and validate Aviation Weather knowledge questions for use with subsequent General Aviation Weather research.
Knowledge questions

• 95 Aviation Weather questions ("items")
• **Team**: 2 meteorologists, 1 flight instructor, 1 I-O/HF Psychologist, 2 HF graduate students
• **Item content**: driven by task analysis, FAA documents, ACS codes, AFS 630 content guidelines
• **Item format**: driven by AFS-630 item writing guide
• **Item level of learning**: driven by research guidelines and AFS-630 item difficulty level guidelines (Rote, understanding, application, correlation).
• **Content validation**: FAA personnel
Method
Participants

- N = 204 (June – September 2016)
  - ERAU Affiliated = 133; Non-ERAU = 71
  - Part 61 = 60; Part 141/142 = 143
  - Flight hours
    - Mean = 201.4
    - Median = 131
- Pilot Certificate and/or Rating
  - Student pilots = 41
  - Private pilots = 72
  - Instrument = 50
  - Commercial = 41
- Years Flying; Mean = 3.6
Procedure

- Informed consent
- Completed Demographic information and Attitudinal measures
  - Self-efficacy (Confidence)
  - Weather salience
- Completed knowledge questions
  - Computer-based (at ERAU); Randomized
  - Paper-based (OshKosh)
- Paid $20 + $0.31 per correctly answered question (ERAU students)
- Debriefed by Experimenter (Graduate Research Assistant)
RESULTS
Overall Aviation Weather Knowledge Score (% Correct)

- 95 Questions (Cronbach’s alpha = .92)

<table>
<thead>
<tr>
<th>Category</th>
<th>n</th>
<th>M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private-in-Training</td>
<td>41</td>
<td>47.65 (13.61)</td>
</tr>
<tr>
<td>Private</td>
<td>72</td>
<td>56.62 (15.67)</td>
</tr>
<tr>
<td>Private with Instrument</td>
<td>50</td>
<td>61.77 (12.93)</td>
</tr>
<tr>
<td>Commercial with Instrument</td>
<td>41</td>
<td>65.62 (14.50)</td>
</tr>
</tbody>
</table>

* One-way ANOVA Significant between groups effect
Scores on Aviation Weather Knowledge Categories (Lanicci et al., 2011, 2016)

- Weather Phenomena
  - 31 Questions; alpha = .76
- Weather Hazard Products
  - 80 Questions; alpha = .91
- Weather Hazard Product Sources
  - 10 Questions; alpha = .66
- 3x4 Mixed ANOVA
  - 2 Significant Main effects
  - No significant Interaction effect
Weather Phenomena Subcategories

- 4 x7 Mixed ANOVA
- Impact of Pilot Certificate/Rating and Weather Phenomena Subcategories on Score
- Both main effects were significant; no interaction
- Main effect for Weather Phenomena
  - Icing and Turbulence ($\approx 70\%$)
  - Definitions of LIFR, IFR, MVFR, and VFR ($\approx 65\%$)
  - Thunderstorms, Satellite, Radar, and Lightning concepts ($\approx 60\%$ and below)
Weather Hazard Products Subcategories

- 4 x7 Mixed ANOVA
- Impact of Pilot Certificate/Rating and Weather Hazard Product Subcategories on Knowledge Score

- Two significant main effects; no interaction
- Main effect for Weather Hazard Product
  - Interpreting upper level charts (≈75%)
  - Interpreting convective SIGMETs and surface charts (≈ 65 %)
  - Interpreting surface weather and PIREPS, AIRMETS, satellite data, infrared visible, water vapor, and radar (≈55%)
Weather Product Hazard Source Subcategories

- 4 x 3 Mixed ANOVA
- Impact of Pilot Certificate/Rating and Weather Hazard Product Sources Subcategories on Knowledge Score
- Both main effects were significant; no interaction
- Main effect for Weather Hazard Product Source Subcategories
  - When to use weather product sources (≈ 72%)
  - Weather issues in Flight planning in general (≈ 70%)
  - How flight plan weather products are constructed (≈ 70%)
Good news – Training helps!

* One-way ANOVA
  Significant between groups effect
**Training Experience**

Estimated Months since last Weather Training

<table>
<thead>
<tr>
<th>Category</th>
<th>M (SD)</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private-in-Training</td>
<td>4.53 (7.81)</td>
<td>2.00</td>
</tr>
<tr>
<td>Private</td>
<td>12.55 (29.46)</td>
<td>5.50</td>
</tr>
<tr>
<td>Instrument</td>
<td>12.53 (27.51)</td>
<td>5.50</td>
</tr>
</tbody>
</table>

(Note: Private with instrument reported 8 months, and Commercial pilots reported 19+ months)
DISCUSSION and CONCLUSION
Discussion

• Test questions/Instrument:
  ▫ Used a systematic approach that followed guidelines in assessment instrument development.
  ▫ Measure has content validity and initial evidence that scores discriminate between pilots of differing levels of training.
  ▫ Instrument generated a spread of scores reflecting both high and low aviation weather knowledge.

• GA Pilots knowledge
  ▫ Results indicate gaps in aviation weather knowledge!

• Limitations/Future Research
  ▫ Need to assess criterion validity of questions
  ▫ Need older GA pilots to take the questions

• *Current study provides an instrument that can assess GA pilot weather knowledge, and in turn, assess future Wx Training Programs.*
Questions?