Helping GA pilots interpret NEXRAD in Convective Weather Situations

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Problem

- Research has shown that GA pilots using data linked NEXRAD Radar do not understand all the facets of radar.
  - Used data link radar for tactical decision making (Latorella & Chamberlain, 2002).
  - Made tactical decisions when the radar resolution was higher (Beringer & Ball, 2004).
Purpose of current study

Further evaluate the Roberts et al. (2011) course:

- non-ERAU or current university students
- another region of the U.S.
- Part 61
Current Study

- 2 x 3 Mixed Design
- Independent Variables:
  - Location
    - KC x Chicago x Boston
  - Training
    - Pre-training scores x Post-training scores
- Dependent Variables
  - Radar Knowledge Test
  - Scenario Application Test
  - Self-Efficacy Questionnaire
Participants

- **Kansas City**
  - N = 24
  - Age: M = 58.9 (SD = 10.0)
  - Flight hours: M = 2348.3 (SD = 2832.83) Mdn = 765
  - 20 held instrument rating

- **Chicago**
  - N = 18
  - Age: M = 58.2 (SD = 10.6)
  - Flight hours: M = 2370.6 (SD= 4150.13) Mdn = 487.5
  - 14 instrument rating

- **Boston**
  - N = 32
  - Age: M = 50.7 (SD= 14.8)
  - Flight time: M = 2363.8 (SD = 4998.49) Mdn = 380
  - 19 instrument rating

- Recruited through flying clubs, the Civil Air Patrol, and flyers posted in FBO’s
- Participants compensated with $50 and WINGS credit (and lunch).

Robert et al. (2011):

31 ERAU pilots received course
Mean age: 21.8 years
Mean flight time: 328.47 hours
### Participants

Participants by FAR training part and location

<table>
<thead>
<tr>
<th></th>
<th>Private</th>
<th>Commercial</th>
<th>Air Transport Pilot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part 61</td>
<td>Part 141</td>
<td>Part 61  Part 141</td>
</tr>
<tr>
<td>Kansas City (KC)</td>
<td>24</td>
<td>18</td>
<td>3  9  3</td>
</tr>
<tr>
<td>Chicago</td>
<td>18</td>
<td>12</td>
<td>3  5  3</td>
</tr>
<tr>
<td>Boston</td>
<td>32</td>
<td>26</td>
<td>1  9  1</td>
</tr>
<tr>
<td>Overall</td>
<td>74</td>
<td>56</td>
<td>7  23  7</td>
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</tbody>
</table>

Note: Not all participants responded to this portion of the questionnaire.
Training Module

- Lecture based course
- Radar Basics, NEXRAD, Radar Modes, Thunderstorms, Using NEXRAD for Decision Making
- Two paper-based flight scenarios
  - Learners applied knowledge from course to respond to questions
  - Instructor gave feedback
- ~ 2 hours; breaks as needed.
Procedure

- Consent & Pre-test
- Course module
- Lunch
- Practice Scenarios
- Post-test
  - Parallel form questions
  - Additional novel scenario
- Debrief & compensation
- Total time: 6 hours
Effect of Training

Radar Knowledge Test:

- $F(1, 69) = 218.50, p < .001, \eta^2 = .76$
Effect of Training

Scenario Tests:

- $F(1, 69) = 170.58, p \leq .01, \eta^2 = .712$
- Pretest: 65%
- Posttest 1: 85%
- Posttest 2: 71%
Effect of training

Self-Efficacy Questionnaire:

- \( F(1, 69) = 94.32, p \leq .001, \eta^2 = .58 \)
Reactions

- Participants rated the course highly
- $M = 6.54 \ (SD = 0.51)$
- $(1 = \text{Low, } 7 = \text{high})$
Course appears to be effective with typical GA pilots.

Similar pattern of results to Roberts et al. (2011).

Course was given by a “naïve” instructor.

Pre-test scores indicated pilots have limited knowledge about weather radar.

Limitations: no control group; no retention test; no performance (flight) data.

This short course has potential to increase pilots’ interpretation of in-cockpit weather radar displays.
Thank you!

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Comparison Study

- 2 x 3 Mixed Design
- Training (pre vs. post)
- Condition: 3 levels:
  - Embry-Riddle control group (Roberts et al., 2011 dataset)
  - Embry-Riddle experimental group (Roberts et al., 2011 dataset)
  - General Aviation group (Current dataset)
    - Randomly selected 30
Interaction of Training and Condition

- Radar Knowledge

![Radar Knowledge Scores](image)
Interaction of Training and Condition

- Scenario Test

![Scenario Scores](image)
Interaction of Training and Condition

- Self-Efficacy

![Self-Efficacy Responses Graph](image)
All performed significantly better than the ERAU control group

GA pilots outperformed the ERAU pilots
  - GA pilots draw from greater experience?
  - Course instructor was more effective in the GA condition?
  - GA pilots more motivated?

*Overall, course has strong potential to help GA pilots understand NEXRAD*
Thank you!

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MANOVA Results

- Significant main effect of training (pre vs. post)
  - \( \text{Wilks lambda } F(3, 67) = 142.24, \; p = .001, \; \eta^2 = .86.4 \)
- Significant main effect of location
  - \( \text{Wilks lambda } F(6, 134) = 3.00, \; p = .009 \)
- No significant interaction
  - \( F(6, 134) = .76, \; p = .605 \)
Location: Univariate follow-up

- MANOVA revealed significant effect of location
- Univariate revealed no main effect for location
  - Radar Knowledge: $F(2, 69) = .877, p = .420$
  - Scenario: $F(2, 69) = 2.05, p = .136$
  - Self-Efficacy: $F(2, 69) = .239, p = .788$
- Uneven groups
MANOVA revealed a significant main effect for each:

- **Condition**: $F(6, 170) = 16.09, p \leq .001, \eta^2 = .36$
- **Training**: $F(3, 85) = 40.54, p \leq .001, \eta^2 = .58$

- **Condition x Training**: $F(6, 170) = 31.16, p \leq .001, \eta^2 = .52$. 
<table>
<thead>
<tr>
<th></th>
<th>Pretest Mean</th>
<th>Pretest SD</th>
<th>Posttest Mean</th>
<th>Posttest SD</th>
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<tbody>
<tr>
<td><strong>Radar Knowledge Scores</strong></td>
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<tr>
<td>Control ERAU</td>
<td>65.00%</td>
<td>8.77%</td>
<td>55.66%</td>
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<tr>
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<td>66.15%</td>
<td>8.08%</td>
<td>79.80%</td>
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<td>56.04%</td>
<td>12.55%</td>
<td>76.59%</td>
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<tr>
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<td>14.72%</td>
<td>56.86%</td>
<td>13.23%</td>
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<td>13.80%</td>
<td>75.76%</td>
<td>10.69%</td>
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<tr>
<td>Experimental GA</td>
<td>64.04%</td>
<td>15.64%</td>
<td>86.14%</td>
<td>10.20%</td>
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<td><strong>Self Efficacy Scores</strong></td>
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<tr>
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<td>1.23</td>
<td>2.49</td>
<td>1.1</td>
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<tr>
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<td>4.02</td>
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<td>3.42</td>
<td>0.41</td>
<td>3.83</td>
<td>0.533</td>
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