Aptitude Test Validations: Choose Your Criterion Wisely

A Validation of the Canadian Forces Aptitude Test (CFAT) for Avionics Systems Technicians

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Outline

• Background
  – Avionics Systems Technician (AVS Tech)
  – Current Selection Model
  – Previous CFAT Validation

• Aim

• Methodology

• Results
  – Establishing a cut-off

• Discussion

• Conclusion
Background: AVS Techs

– members of the Royal Canadian Air Force (RCAF);
– primarily work at air bases in maintenance sections;
– trained in performance oriented electronics (POET - 30 weeks) followed by avionic systems training (QL3 – 24 weeks);
– responsible for all electronic systems onboard Canadian Armed Forces (CAF) aircraft; and
– complete performance tests and preventative/corrective maintenance on aircraft communication, navigation and flight control systems.
Background: Current Selection Model

**Personal Attributes**

**Ability (Can do)**
- Cognitive Ability

**Personality (Will do)**
- Work Ethic
- Dependability
- Achievement Striving
- Stress Management
- Organizational Citizenship

**P-J/P-O Fit (Want to do)**
- Academic Achievement
- Interest Congruency
- Knowledge of MOC
- MOC-related skills
- Realistic Expectations

**Predictors**

- **CFAT**
- **Personality Testing**
- **Interview**
- **Academic History**

**Criteria**

**Performance**
- Basic Training
- Occupational Training
- Job Performance
Background: CFAT

- 3 Subscales:
  - Verbal Skills (VS)
  - Spatial Ability (SA)
  - Problem Solving (PS)

- Typical occupation based CFAT cut-offs are based on total score, PS or a combination of VSPS
Background: Previous Research

- Pre-2010: CFAT cut-off score of 40th percentile for PS subscale
- 2010: validation based on their basic occupation qualification course suggested a cut-off of 50th percentile for composite score of VSPS (Piasentin, 2010)
- 2010-present: Training failures increased to 27.7%
  - Could validation have been strengthened by using POET training?
Aim

• Use best practices to establish an appropriate CFAT cut-off score for AVS Techs accounting for all phases of training
Methodology

• Sample:
  – 317 individual AVS Techs who began POET between 2010 and 2016;
    • 259 Anglophone, 56 Francophone and 2 unspecified

• Predictor
  – CFAT subscales: VS, SA and PS, CFAT Total

• Criterion
  – Overall academic score made up of 21 performance objectives (POs) that are theoretical or practical (e.g., AC/DC circuits)
  – Minimum pass mark 70%
## Results

**Table 1: Correlations between the overall academic score and CFAT for Anglophone AVS Techs**

<table>
<thead>
<tr>
<th></th>
<th>VS</th>
<th>SA</th>
<th>PS</th>
<th>VSPS</th>
<th>CFAT Total</th>
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</tr>
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<tbody>
<tr>
<td><strong>VS</strong></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>SA</strong></td>
<td>.15*</td>
<td>-</td>
<td></td>
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<tr>
<td><strong>PS</strong></td>
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*Note: * $p<.05$, ** $p<.01$, $n = 259$*
## Results

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Results

- Simultaneous hierarchical regressions were performed
  - PS (highest correlation) and VSPS (previous cut-off)
  - PS (highest correlation) and CFAT Total (2\textsuperscript{nd} highest correlation)

- Neither VSPS nor CFAT added value to predicting training success beyond PS
  - Model 1: PS entered first ($F (1, 257) = 58.068, p = .000$, with an $R^2 = .184$ and $\Delta R^2 = .184$) followed by VSPS ($F (1, 256) = .018, p = .894$, with an $R^2 = .184$ and $\Delta R^2 = .000$)
  - Model 2: PS entered first ($F (1, 257) = 58.068, p = .000$, with an $R^2 = .184$ and $\Delta R^2 = .184$) followed by CFAT Total ($F (1, 256) = 2.048, p = .154$ with an $R^2 = .191$ and $\Delta R^2 = .006$)
Establishing a Cut-Off Score

- A linear regression was performed using PS as the predictor
- Regression equation: \( Y = (0.087) + (0.029)X \)

**Table 2: Quartiles of the PS Score for Anglophone AVS Techs**

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Academic Score</th>
<th>PS Raw Score</th>
<th>PS Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>71%</td>
<td>21</td>
<td>74(^{th})</td>
</tr>
<tr>
<td>50</td>
<td>85%</td>
<td>26</td>
<td>92(^{nd})</td>
</tr>
<tr>
<td>75</td>
<td>90%</td>
<td>28</td>
<td>97(^{th})</td>
</tr>
</tbody>
</table>
Establishing a Cut-Off Score

Table 3: Means and SDs of the PS score for Anglophone AVS Techs.

<table>
<thead>
<tr>
<th></th>
<th>Passed POET Mean</th>
<th>Passed POET SD</th>
<th>Passed POET CI</th>
<th>Failed POET Mean</th>
<th>Failed POET SD</th>
<th>Failed POET CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS</td>
<td>22.57</td>
<td>4.12</td>
<td>22 - 23</td>
<td>19.35</td>
<td>4.26</td>
<td>18 - 20</td>
</tr>
<tr>
<td></td>
<td>(78th percentile)</td>
<td></td>
<td></td>
<td>(65th percentile)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: PS score cut-off recommendation for AVS Techs.

<table>
<thead>
<tr>
<th></th>
<th>Anglophone PS Score</th>
<th>Anglophone Percentile</th>
<th>Francophone PS Score</th>
<th>Francophone Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>21.0</td>
<td>74th</td>
<td>22.0</td>
<td>74th</td>
</tr>
<tr>
<td>Adjusted (1 SEM)</td>
<td>18.7</td>
<td>60th</td>
<td>20.0</td>
<td>60th</td>
</tr>
</tbody>
</table>
Discussion

• Recommendation
  – Implement cut-off of PS (74th percentile; raw score 21 for Anglophones, 22 for Francophones)
  – Allow for flexibility during times of high intake by lowering cut-off to the 60th percentile (raw score of 18 for Anglophones and 20 for Francophones)
  – Continue to use POET training as criterion data for future validations
Conclusion

• Working with operators helped determine where training failures occur

• Allowing some flexibility can support foreseeable contextual factors