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Pilot Selection Research Gaps: What We Do and Don't Know About "The Right Stuff"

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Background

- Proper aviation candidate selection is essential for success in training and job performance (Wickens, Liu, & Becker, 2004).
- Aptitude and personality traits are predictive of pilot performance (Ree & Carretta, 1996).
  - Top-performing pilots possess certain cognitive and personality traits that separate them from the rest of the population (e.g. situational awareness, psychomotor skills, emotional stability)
- Aptitude batteries and personality questionnaires have been used for military and airline pilot selection (Martinussen, 1996; Carretta and Ree, 2000)

History of Pilot Selection

Photo courtesy of the national archives

History of Pilot Selection

- Early pilot selection methods focused on physiological fitness for military aviation.
  - The first aerospace researchers measured flight aptitude with ergoestesiographs, swivel chairs, and hypobaric chambers (Galloni, 2017).
  - Henmon (1919) developed tests that measured emotional stability, mental alertness, perception of tilt, and perception of swaying.
- During WWII, self-selection was often used in the US Military to fill pilot slots
  - Frequent accidents prompted the development of mental aptitude battery tests.
  - Mental aptitude tests focused on arithmetic reasoning, mechanical principles, and instrument comprehension (Flanagan, 1942; Thorndike, 1949)

Current Selection Methods & Validity

	Four Key Criteria for Selection Methods				
Assessment Method	Validity	Adverse Impact (Fairness)	Cost to Develop	Cost to Administer	Applicant Reactions
Cognitive ability tests	High	High (against minorities)	Low	Low	Somewhat favorable
Job knowledge tests	High	High (against minorities)	Low	Low	More favorable
Personality tests	Low to moderate	Low	Low	Low	Less favorable
Biographical data inventories	Moderate	Low to High for different types	High	Low	Less favorable
Integrity (Honesty) tests	Moderate to high	Low	Low	Low	Less favorable
Structured Interviews	Moderate to high	Low	High	Low	More favorable
Physical Fitness tests	Moderate to high	High (against Females & Older Workers)	High	High	More favorable
Situational Judgment Tests	Moderate	Moderate (against Minorities)	High	Low	More favorable
Work Samples (including Simulation)	High	Low	High	High	More favorable
Assessment Centers	High	Low	High	High	More favorable

Adapted from Pulakos, E. (2005). *Selection assessment methods: A guide to implementing formal assessments to build a high-quality workforce.* Alexandria, VA: SHRM Foundation. Used with permission.

Pilot Selection Research: Cognitive Abilities

- Cognitive ability is considered one of the most important human performance factors in the cockpit.
  - Pilots are generally more intelligent than the average U.S population (Krazt, Poppen, Burroughs, 2007)
  - Measurements of general intelligence or "g" have been found to have high validity in military pilot selection. (Ree & Carretta, 1996).
- Previous knowledge or motivation are essential supplements to cognitive ability (Zierke, 2014)
- Psychomotor/multi-tasking tests are often used to measure situation awareness and attention management (Caponecchia, Zheng, & Regan, 2018).

Pilot Selection Research: Personality

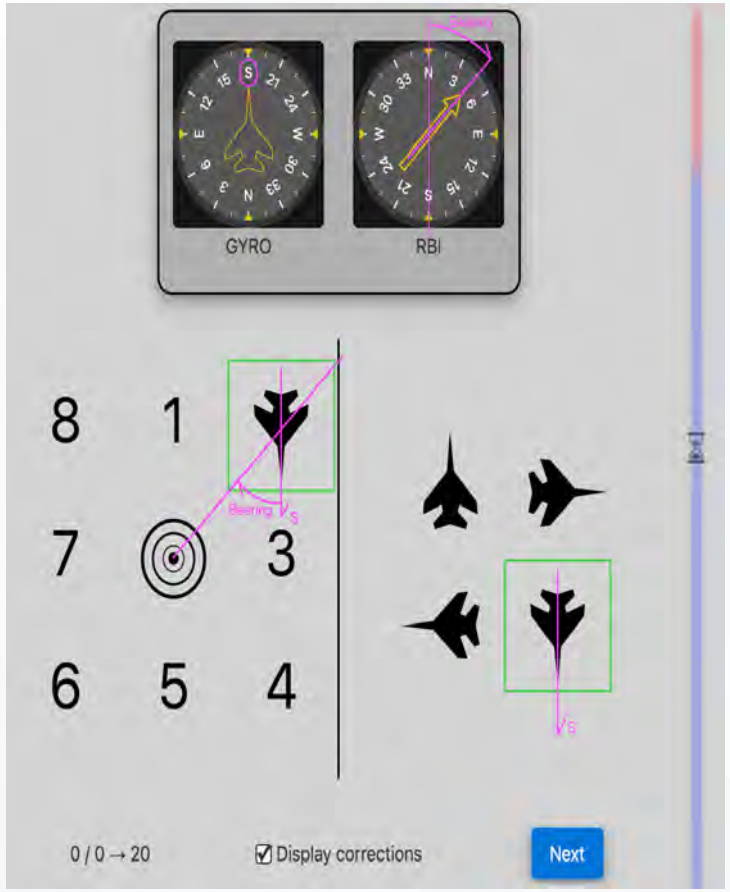
- German scientists were among the first to examine personality for pilot selection (Harell & Churchill, 1941).
- Based on the “Big 5” NEO PI-R, student civilian pilots tend to score higher agreeableness and conscientiousness than non-pilots (Gao & Kong, 2016).
- Callister (1999) found that male USAF pilots tend to be friendly, assertive, confident, competitive, excitement-seeking, and not vulnerable in high-stress situations.
    - Females have a similar traits but are more “open to new experiences”
- Personality tests are not heavily weighted in pilot selection due to low predictive validities (Hardison, Sims, & Wong, 2010).

How We Predict Pilot Performance (Based On Martinussen, 1996)

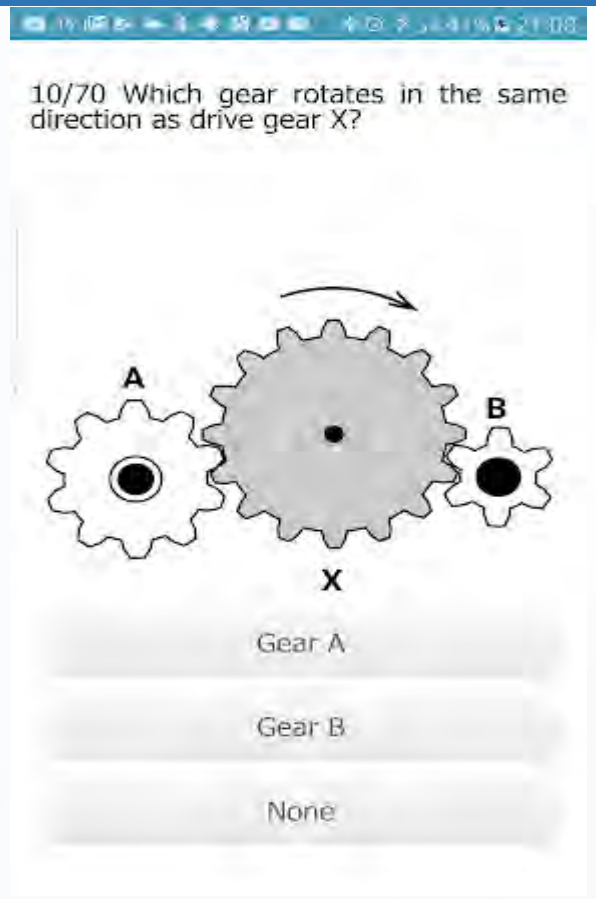
Test/Predictors	N	K	Mean r (uncorrected)	Mean r (corrected)	90% CV
General Intelligence	15,403	26	.13	.16	.03
Cognitive Ability Tests	17,900	35	.22	.24	.07
Psychomotor/Information Process	8,522	29	.20	.24	.10
Combined index (several sub-tests)	5,362	14	.31	.37	.19
Aviation Information	3,736	16	.22	.24	.14
Academic Grades	4,267	9	.15	.15	.11
Training experience (flying)	5,806	10	.25	.30	.07
Personality Measures	6,304	21	.13	.14	.00
Biographical Inventory	11,347	13	.21	.23	.00

Pilot Mental Aptitude Test- Samples

Wombat (Roscoe, 1993)



Spatial Orientation Test



Mechanical Comprehension Test

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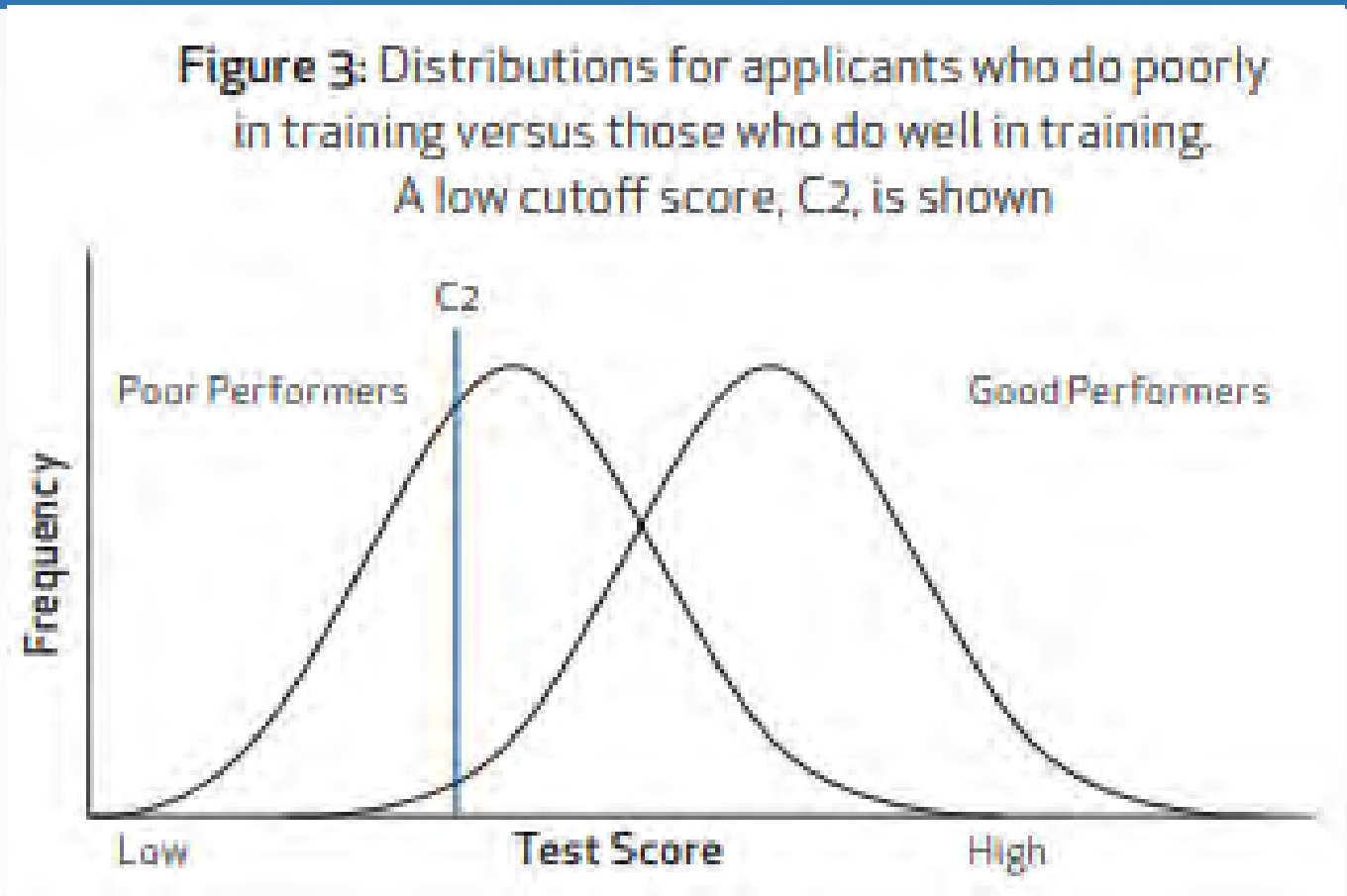
Aptitude Test Scores & Training Performance



Reference: Damos, D.L. (2012). Hiring Pilots During a Shortage: Some Cautions. ICAO Training Report, 2(2), 17-19.

Pros and Cons of Current Selection Methods

Pros

- Aptitude tests are easy to administer.
- The most qualified candidates are typically selected.
- Higher safety and less dropouts throughout training.

Cons

- It takes a long time to develop and validate selection methods.
- Selection tests are only predictive to a certain extent. (Damos, 1995).
- Applicants may have negative reactions towards the selection process.

Future Research

- How can we increase predictive validity of selection methods?
  - Can we predict both training performance and long-term performance?
  - Does the type of aircraft or operation require different cognitive skills? (i.e., are fighter pilots different from civilian pilots on some level of skill or ability?)
  - How does cognitive ability in the context of personality and motivation predict performance?
- Are there other relevant attributes or competencies not assessed in paper-pencil tests that could effectively predict pilot performance?
- Can industry exigencies and pilot selection criteria be balanced?

Questions?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