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Trent, J. D., & Rose, M. R. (2021). Measuring Motivation in Pilot Training Applicants. *90th International Symposium on Aviation Psychology*, 25-29.

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MEASURING MOTIVATION IN PILOT TRAINING APPLICANTS

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This study evaluated applicant motivation in pilot selection. Traditional measures of motivation have moderate to low predictive validity in flight training and often show large subgroup differences. The purpose of this study was to evaluate a self-report measure of motivation by examining 1) dimensionality, 2) reliability, 3) predictive validity, 4) construct validity, 5) validity based on known groups, and 6) subgroup differences. In a sample of 16,911 pilot applicants, a composite score correlated $r = .37$ with success in flight training and provided predictive validity beyond current measures of motivation. Differences between subgroups were small to medium. Thus, a self-report measure may be a better indicator of motivation than measures that come at a substantial financial cost (e.g., flight hours). As a result, it may be possible to improve pilot selection, decrease training costs, and make training more accessible to a wide range of applicants.

Motivation has been theorized to be one of three essential determinants of performance, along with declarative and procedural knowledge (Campbell, Gasser, & Oswald, 1996). Consistent with the importance of the concept, there has been a profusion of work motivation theories over the past 50 years (Muchinsky & Howes, 2019), and vast research documenting positive relations of motivation to performance in educational (Conti, 2000; Tanaka & Yamauchi, 2001) and work (Joo et al., 2010; Li et al., 2015) settings.

Nonetheless, as it pertains to training for a pilot career, there have been few empirical attempts to understand motivation. One exception is research that examined whether students who were more internally motivated would be more successful in flight training (Frederick-Recascino & Hall, 2003). The study, which evaluated 193 archival student records, found that student motivation operationalized as number of times a student cancelled their flight lessons, accounted for a significant amount of variance in flight performance, measured through number of lessons required to graduate, performance on written exams, and grade-point average (Frederick-Recascino & Hall, 2003).

Other exceptions have been attribute rating and biodata studies. For example, achievement motivation was ranked highest out of 27 cognitive and non-cognitive attributes by Air Force fighter pilots for relevance to major tasks (Carretta et al., 1993). Also, biodata has had a long history of success in predicting pass/fail in flight training. For example, Henry (1966, as cited in Hough, 1988) reported that the item “Did you ever build a model airplane that flew?” was almost as good a predictor of pilot training success as the entire Air Force test battery. Use

of biodata has apparently been curtailed in US pilot selection due to issues such as differential prediction by sex (Damos, 2011).

Finally it has been proposed that measures of aviation knowledge and flying hours may function in part as indicators of general interest and motivation in aviation. For example, because the U.S. Air Force's aviation knowledge test is administered pre-accession, before undergoing any required training, it may measure variance that can be attributed to motivation. Applicants with high motivation for a pilot career may be more likely to actively pursue opportunities to learn about motivation and dedicate time to self-study in preparation for the test (Barron, Carretta, & Rose, 2016).

The purpose of the current study is to examine preliminary evidence for validity of a measure of motivation to become a pilot by examining 1) evidence of dimensionality in a group of pilot applicants, 2) reliability estimates by dimension, 3) evidence for predictive criterion-related validity, 4) evidence for convergent and discriminant validity, 5) evidence for validity based on known groups, and 6) subgroup group differences for males and females as compared to measures sometimes assumed to be indicators of motivation – aviation knowledge and flying hours. Increased insight into the construct validity and impact of motivation for a pilot career can help to improve the validity and fairness of selection systems used for pilots, critical factors given the substantial cost of pilot training and widely recognized need for increased diversity among pilots.

Method and Results

Participants in this study were 16,911 applicants being considered for at least one of four U.S. Air Force flying careers, who had completed a survey designed to measure motivation for a pilot career. Participants had varying amounts of data on outcome and other measures used to evaluate reliability and validity of the measure, and subgroup differences. The source of items of motivation was the 48 item Work Interest Inventory, a survey initially comprised of 37 items intended to measure motivation for unmanned aircraft pilot careers (Paullin et al., 2011) and later expanded with intentions to measure motivation for manned aircraft pilot careers (Barron et al., 2015).

Initial analyses focused on identifying underlying dimensions of the measure using exploratory factor analysis, and conducting internal consistency reliability analyses of the dimensions. Results showed that the Work Interest Inventory measures seven dimensions with coefficient alpha reliability estimates that ranged from .61 to .91 (Table 1).

Table 1.
Factor Analysis of Work Interest Inventory Items.

Prompt: Rate how important each job characteristic is to your *ideal job*.

Scale: 1 = *This is something I would actively try to avoid in a job* to 5 = *This is something I would actively seek out as part of a job.*

Dimension	Description
Performance Under Pressure ($\alpha = .91$)	Seeks out work that involves multitasking and working under high stress conditions.
RPA-Specific Working Conditions ($\alpha = .81$)	Favors a work context and tasks typical for RPA operators (e.g., focused on reconnaissance).
Manned-Aircraft-Pilot-Specific Tasks ($\alpha = .82$)	Seeks a career that involves using skills of a manned aircraft pilot.
Competitive/Independent ($\alpha = .66$)	Seeks a career that provides opportunities to compete with other and make independent decisions.
Sociable ($\alpha = .75$)	Seeks out work that allows for interaction with coworkers.
Cutting Edge Technology to Protect ($\alpha = .61$)	Seeks out work that involves using cutting edge technology to help others.
Lethal Action ($\alpha = .65$)	Seeks a career that involves application of lethal force.

We then conducted logistic regression analysis, regressing manned aircraft pilot training success on the extracted dimensions. Dimensions with theoretical and empirically stronger relationships to training success were used to compose the preliminary measure of motivation for a manned aircraft pilot career. We next evaluated the measure's convergent and discriminant validity, using other components of the Air Force pilot selection test battery, and examined subgroup differences.

Validity analyses showed that three dimensions in particular, labeled Manned-Aircraft-Pilot-Specific Tasks, Sociable, and RPA-Specific Working Conditions, were significant predictors and a unit weighted composite score correlated .37 with pilot training success. This composite score also correlated .40 with a one-item measure of interest in a manned aircraft pilot career, .46 with pilot training success when combined with the interest measure (Table 2), and predicted success beyond flying hours and aviation information.

Table 2.
Means, Standard Deviations, and Correlations of Variables.

Variable	Mean	SD	1	2	3	4	5	6
1. Pilot Motivation (PM)	6.36	8.67	1.00					
2. Career Interest (CI)	0.87	0.34	.40**	1.00				
3. Flying Hours	2.40	3.15	.25**	.21**	1.00			
4. Aviation Knowledge	11.91	4.17	.23**	.15**	.56**	1.00		
5. PM + CI	1.37	1.78	.84**	.83**	.28**	.23**	1.00	
6. Training P-F	0.87	0.33	.37**	.39**	.25**	.29**	.46**	1.00

Finally, subgroup differences for groups based on gender, race, and ethnicity were small to medium (Table 3).

Table 3.
Cohen's d Values for Variables by Subgroup.

Variable	Male - Female	Black/African American - White	Hispanic- Non-Hispanic
Pilot Motivation	.16	.42	.12
Flight Hour Code	.23	.16	.21
Aviation Knowledge	.66	.53	.30

Discussion

These results have several implications. First, the measure of motivation appears to provide substantial incremental validity beyond other motivation-relevant U.S. Air Force selection tools. Similarly, a relatively simple self-report measure of motivation may be a better indicator of motivation than measures that come at a substantial financial cost to applicants (e.g., flying hours), especially when paired with a simple measure of interest in a pilot career. As a result, it may be possible to improve selection of applicants into training, decreasing costs related to attrition and making training more accessible to a wide range of applicants. Further study is needed to determine the extent to which these results generalize to future applicants.

Acknowledgements

The views expressed in this paper are those of the authors and are not necessarily those of the U.S. Government, Department of Defense, or the U.S. Air Force.

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