

Cognitive Ability and the Prediction of UAV Team Members' Performance. *Hinsz, V.¹, Ladbury, J.¹, & Park, E.²; North Dakota State University¹, Cleveland State University².*

An issue that has arisen during previous Human Factors of UAVs Workshops concerns the specific abilities that might be used to select UAV operator teams. This paper describes a study of cognitive abilities in the performance of UAV operators in a synthetic UAV task environment. Participants ($n = 250$) responded to three different spatial orientation ability measures: Card Rotations Test, Map Planning Task, and Purdue Visualization of Rotations Test.

Participants were trained in performing the air-vehicle operator (AVO) and sensor/payload operator (SO) functions of the Predator UAV. Training and performance occurred within the context of the BRUTE UAV synthetic task environment. Participants completed a training mission which was scored. Subsequently, the participants were randomly assigned to either the AVO or SO functions of a UAV operator team. The dyadic teams ($n = 125$), then performed three missions that increased in complexity. A performance metric was constructed based on the number of targets accurately assessed and the number of flying violations committed (e.g., too high or too low altitude, outside the designated operating area, inside a threat zone).

Each of the three measures of cognitive ability had acceptable to high levels of internal consistency. These values are presented in Table 1 along with the intercorrelations among these cognitive ability tests and the performance for the training and subsequent three missions. Interestingly, all three cognitive abilities tests correlated significantly with each other ($r_s \geq .43$).

The cognitive abilities tests correlated significantly with performance on the training mission ($r_s \geq .24$). This suggests that the cognitive abilities might contribute to long term performance on the tasks, but also be a predictor of success and performance in training in UAV operations. These cognitive abilities tests also predicted scores on a knowledge test taken after training ($r \geq .14$), however, the Map Planning Task did slightly better in predicting these specific knowledge questions. Table 1 indicates that performance on the training mission also correlated with performance on the three subsequent missions at about the same level as the cognitive abilities tests. This indicates that the cognitive abilities tests were as good as initial training performance at predicting UAV task performance.

The cognitive abilities tests also predicted performance on missions 1 and 2, but not consistently for mission 3. Only the Purdue Visualization of Rotations test significantly predicted performance on Mission 3. However, performance on previous missions did predict performance on Mission 3. By Mission 3, performance on the task may have stabilized, and performance was based more on previous experiences and training, and less on cognitive abilities.

The Purdue Visualization of Rotations test was overall a more consistent, and slightly better, predictor of mission performance. Therefore, if limited to one measure for predicting synthetic UAV operators' performance, the Purdue Visualization of Rotations test would be recommended. Future work should examine more closely the cognitive abilities that are predictive of performance in UAV environments to determine what tests should be included in a battery of tests for the prediction of training success and eventual performance.

Table 1.

Intercorrelations among Cognitive Abilities Measures and Performance Scores on the UAV Missions.

	Card Rotations Test	Map Planning Task	Purdue ROT Task	Total Points – Training Mission	Total Points - Mission 1	Total Points - Mission 2	Total Points - Mission 3
Card Rotations Test	.97						
Map Planning Task	.430**	.76					
Purdue ROT Task	.452**	.490**	.81				
Total Points - Training Mission	.245**	.257**	.330**				
Total Points - Mission 1	.325**	.352**	.387**	.595**			
Total Points - Mission 2	.233**	.230**	.254**	.497**	.764**		
Total Points - Mission 3	.106	.108	.215**	.388**	.362**	.370**	

Notes. $N \geq 233$ for each correlation.

Internal consistency for the cognitive abilities measures are on the diagonal.

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).