

Multitasking Performance and the Prediction of Flight Training Success

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The Operational Problem

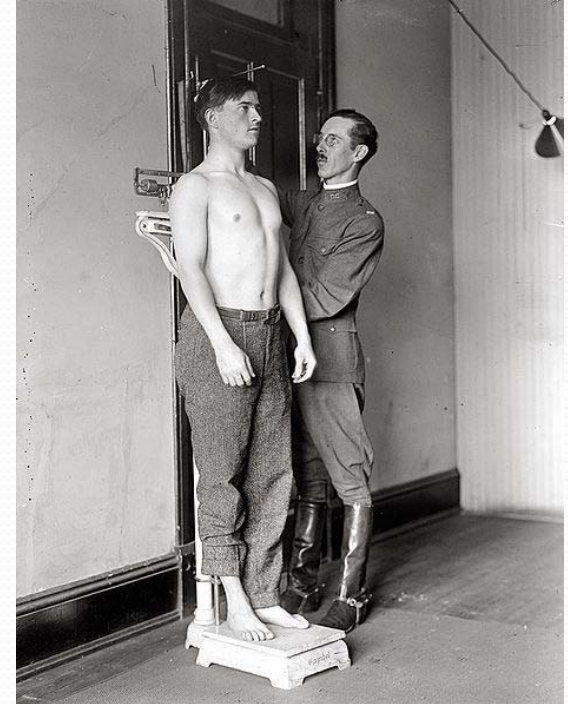
Produce a sufficient quantity of skilled aviators quickly and cheaply

- Aviation training is time consuming and expensive.
- Not everyone has “the Right Stuff”
- Accessing candidates who are likely to succeed will improve efficiency



Evolution of Naval Aviation Selection

- Volunteers
 - High attrition rates
- Unstructured Interview
 - Unscientific, subjective, and ineffective
- Standardized Selection Test
 - 1939-1942 Pensacola Project
 - New versions released in '42, '53, '71, '92



Some of these men have the Right Stuff



...the rest have Ph.D.s in neuroscience

What To Measure?

- Cognitive Ability

?



Current test accounts for 11.4% of variability in primary flight school grades ($r = .338$)

*SAT accounts for 12% ($r = .35$) of 1st year undergraduate GPA
MCAT accounts for 15% ($r = .39$) of 1st year med school grades
LSAT accounts for 5% ($r = .23$) of 1st year law school grades

Implicit Theories of Righteousness

- Cognitive Ability
 - The “Bird Nerd” theory
- Motivation
 - The “Hoo-Ya” theory
- Personality
 - The “Great Personality” theory
- Psychomotor Skills
 - The “Good Hands” theory

Field Opinions

- “...the moxie, the reflexes, the experience, the coolness, to pull it all back in at the last yawning moment.”-Wolfe 1979
- The ability to aviate, navigate, and communicate in that order under pressure.
- Multitasking. They’ve got to be able to do more than one thing at a time.

The ability to multitask under stress.

- *The “Helmet Fire Resistance” theory*

ASTB-E

- Cognitive Abilities
 - Computer adaptive format
- Personality
 - Aviation related traits
 - Fake-resistant format
- Motivation
 - Biographical inventory

PBM

- Maturation of computer and network technologies permits the inclusion psychomotor and multitasking tests.
- Tasks derived from Air Force TBAS
 - One and two dimensional tracking
 - Dichotic listening
 - “Emergency Scenario” task



Tracking Tasks



Task Flow

- Vertical Tracking Task (VTT, 1-D tracking)
- Airplane Tracking Task (ATT, 2-D tracking)
- Simultaneous Airplane and Vertical Tracking
- Dichotic Listening Task (DLT)
- Simultaneous Airplane Tracking, Vertical Tracking, and Dichotic Listening
- Emergency Scenario Task (EP)
 - Airplane and Vertical Tracking with EP resolution

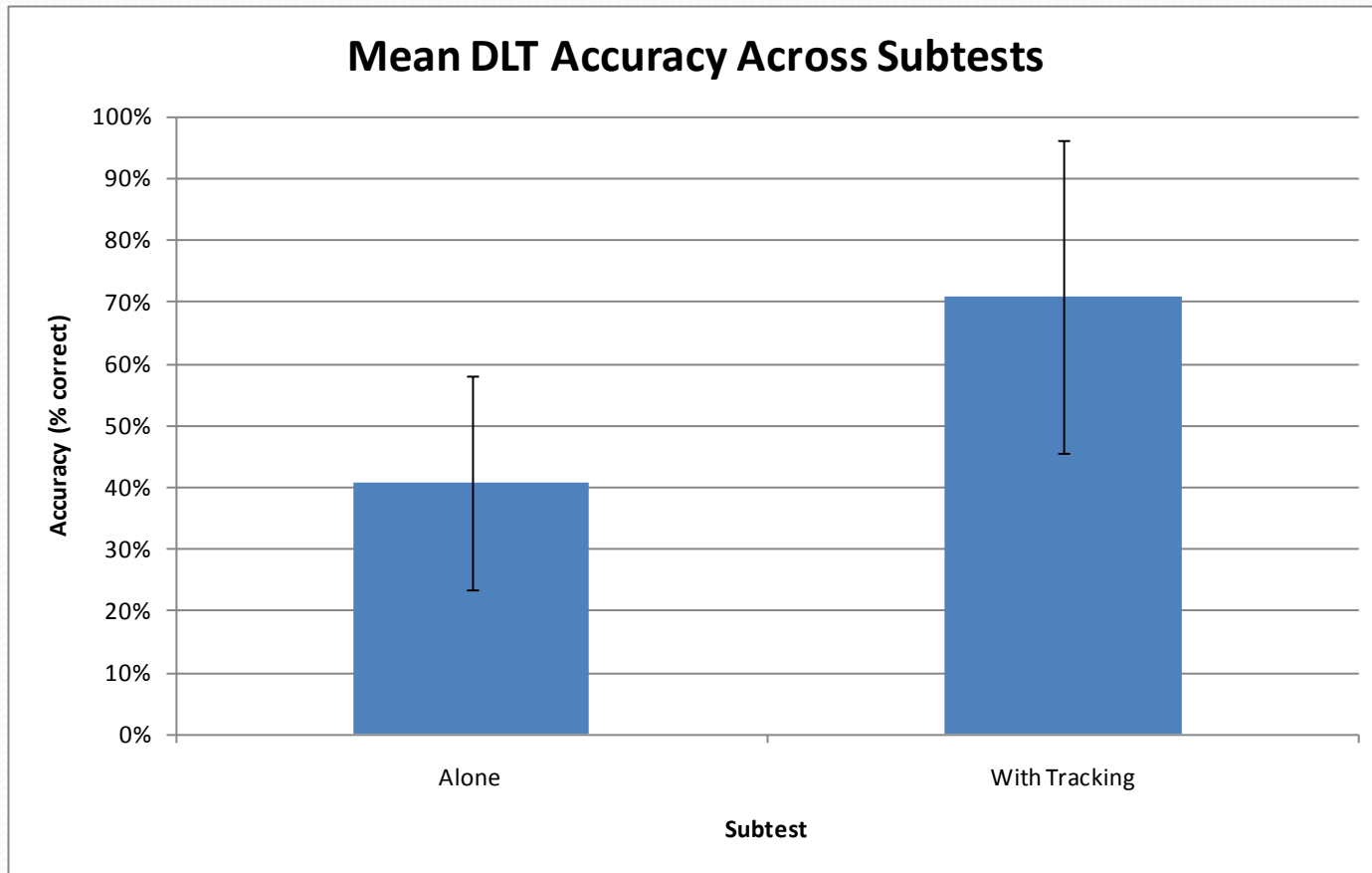
Design

- Test and criterion data for 634 Student Naval Aviators
- All participants tested prior to starting ground school
- Test performance compared to Navy Standard Scores (NSS) during Primary Flight Training

Metrics

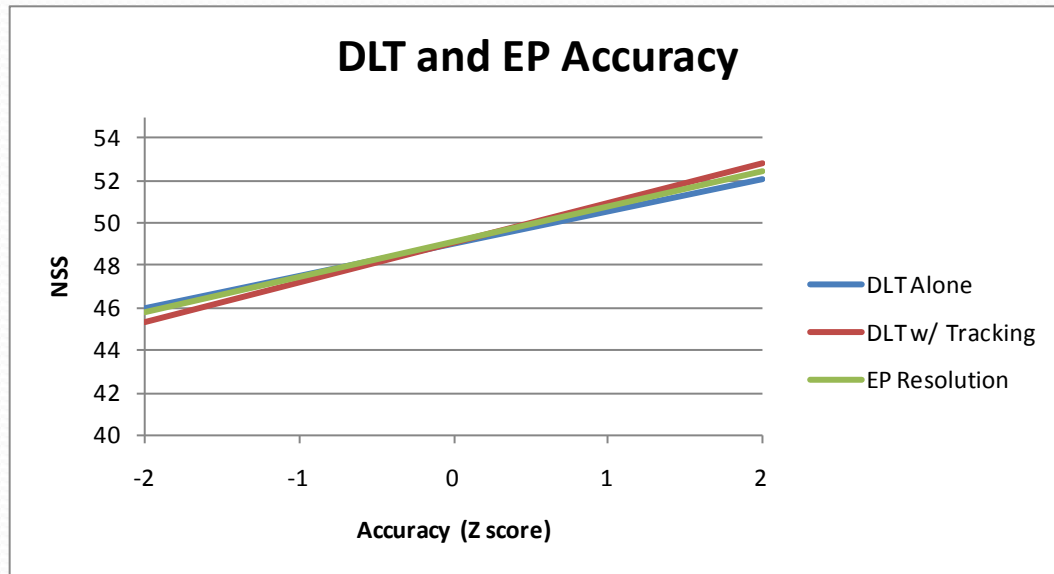
- Tracking Accuracy
 - Mean Euclidian distance between target and cursor throughout subtest
 - Available for each tracking task in each subtest
- DLT Performance
 - Accuracy of performance of Dichotic Listening Task
 - Available from both DLT and ATT + VTT + DLT task
- EP Scenario Performance
 - Accuracy in resolution of EPs in scenario task

Dichotic Listening and Multitasking



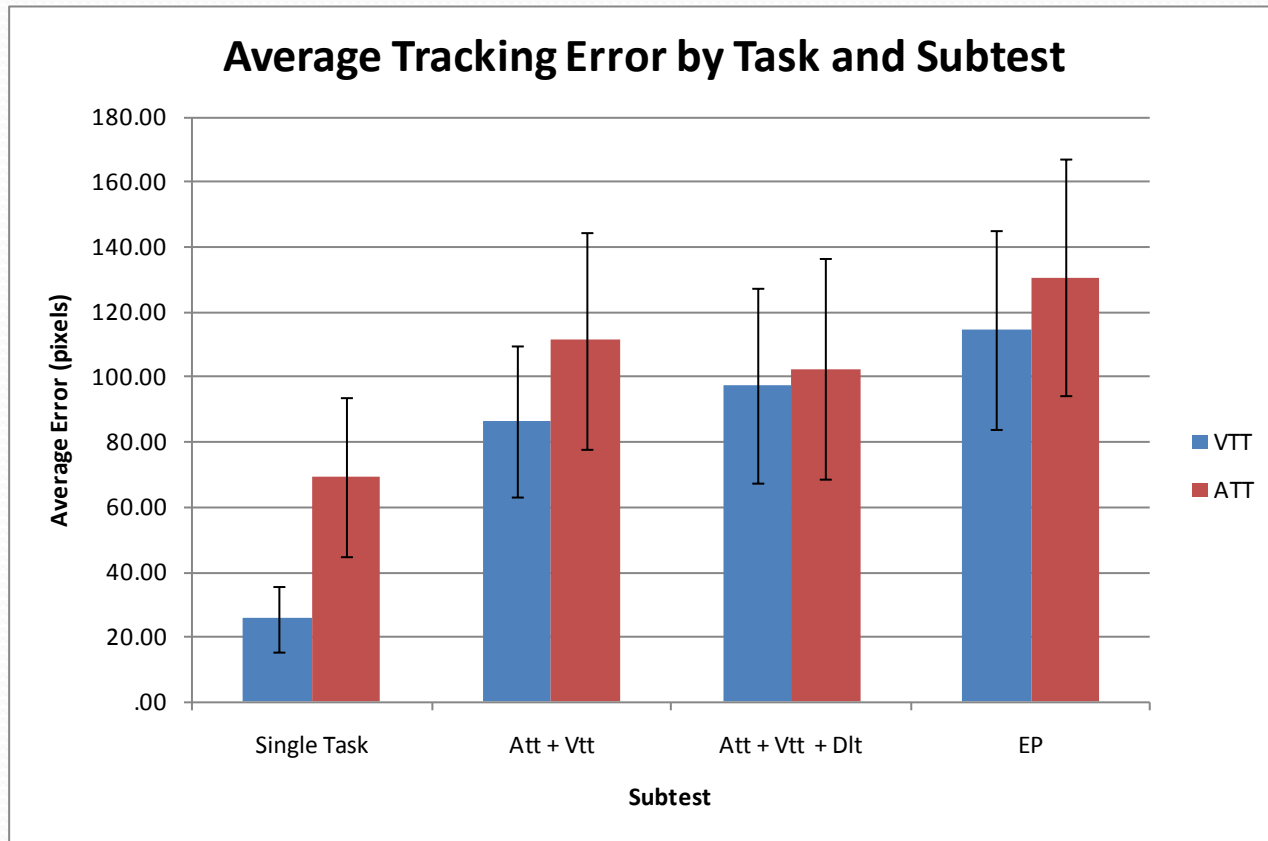
NOTE: Error bars represent one standard deviation

Dichotic Listening, Emergency Scenario, and Flight Grades



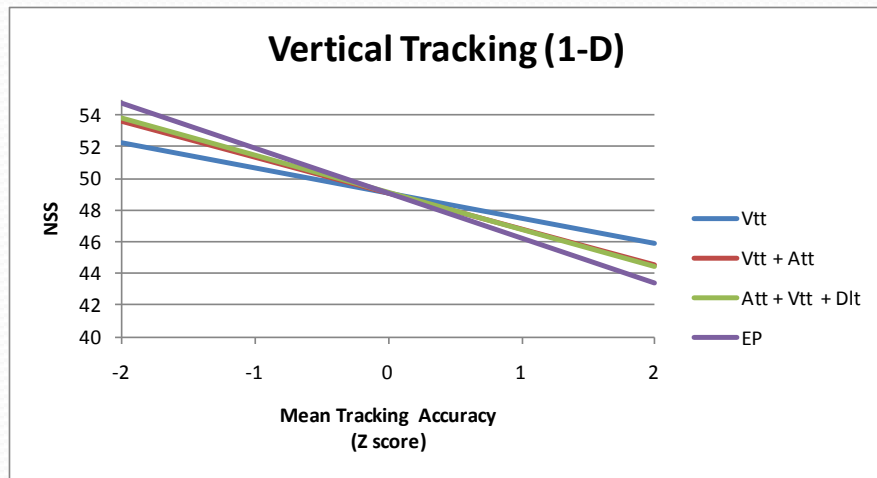
	NSS	DLT Alone	DLT with Tracking	EP Resolution
NSS	1			
DLT Alone	.144**	1		
DLT with Tracking	.174**	.673**	1	
EP Resolution	.158**	.158**	.209**	1

Tracking Performance and Multitasking

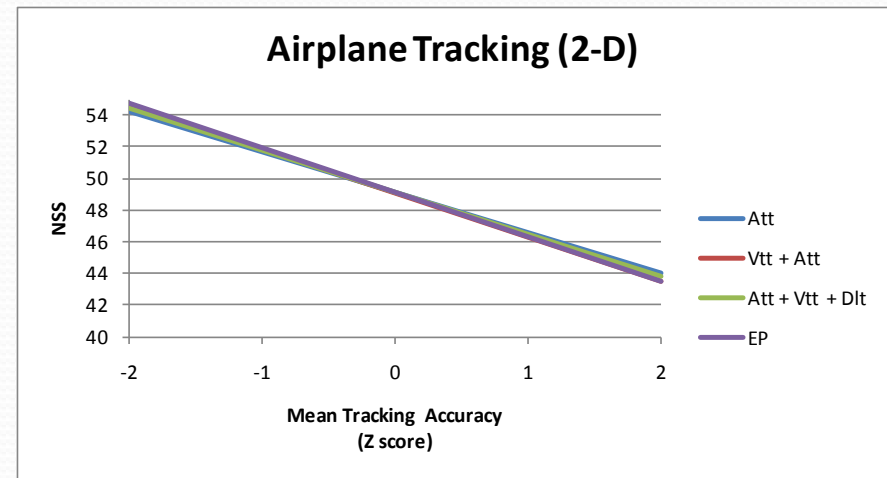


NOTE: Error bars represent one standard deviation

Tracking Performance and Flight Grades



	NSS	Vtt	Vtt + Att	Att + Vtt + Dlt	EP
NSS	1				
Vtt	-.150**	1			
Vtt + Att	-.216**	.462**	1		
Att + Vtt + Dlt	-.223**	.424**	.777**	1	
EP	-.271**	.408**	.685**	.750**	1



	NSS	Att	Vtt + Att	Att + Vtt + Dlt	EP
NSS	1				
Att	-.243**	1			
Vtt + Att	-.264**	.772**	1		
Att + Vtt + Dlt	-.252**	.764**	.887**	1	
EP	-.268**	.581**	.720**	.757**	1

Δ Performance and Flight Grades

	NSS	ΔDLT	ΔVTT (2 Task)	ΔVTT (DLT)	ΔVTT (EP)	ΔATT (2 Task)	ΔATT (DLT)	ΔATT (EP)
NSS	1							
ΔDLT	.037	1						
ΔVTT (2 Task)	-.064	-.067	1					
ΔVTT (DLT)	-.067	-.079⁺	.800^{**}	1				
ΔVTT (EP)	-.111^{**}	-.035	.722^{**}	.786^{**}	1			
ΔATT (2 Task)	-.031	-.059	.108^{**}	.112^{**}	.127^{**}	1		
ΔATT (DLT)	-.015	-.020	.055	.076	.088⁺	.757^{**}	1	
ΔATT (EP)	-.027	-.006	-.005	.033	.236^{**}	.593^{**}	.655^{**}	1

Summary of Predictors

Task	r
VTT (EP)	-0.271
ATT (EP)	-0.268
ATT (Vtt + Att)	-0.264
ATT (Att + Vtt +Dlt)	-0.252
Att Alone	-0.243
VTT (Att + Vtt +Dlt)	-0.223
VTT (Vtt + Att)	-0.216
DLT (Att + Vtt + Dlt)	0.174
EP Resolution (EP)	0.158
Vtt Alone	-0.15
DLT Alone	0.144
Δ VTT (EP)	-0.111
Δ VTT (DLT)	-0.067
Δ VTT (2 Task)	-0.064
Δ DLT	0.037
Δ ATT (2 Task)	-0.031
Δ ATT (EP)	-0.027
Δ ATT (DLT)	-0.015

- Tracking tasks predict flight grades
- Performance under load tends to be more predictive than single-task performance
- Δ metrics generally did not predict flight grades

Stepwise Approach to the Right Stuff

- Stepwise regression to predict NSS
 - Cognitive ability score from current selection test
 - All variables with significant zero-order correlations



Variables included (in order)

- Cognitive Ability Score – $r = .338$
- VTT (EP) – $r = .398$
- ATT (ATT + VTT + DLT) – $r = .411$
- DLT (ATT + VTT + DLT) – $r = .422$

New model accounts for 17.8% of variability in primary flight training grades

PBM Variables
Cognitive Ability

Theories of Righteousness

- “Bird Nerds”
 - Supported – Current ASTB scores remained the #1 predictor among metrics examined
- “Good Hands”
 - Supported – All tracking tasks correlate with flight grades
 - Tracking performance highly correlated across subtests
- “Helmet Fire Resistance”
 - Evidence For – Multitask performance generally more predictive than single task performance
 - Caveats – Delta metrics generally did not work. “Good Hands” may be more parsimonious given inter-test correlations.