Cognitive Function and the Connection to Training Performance

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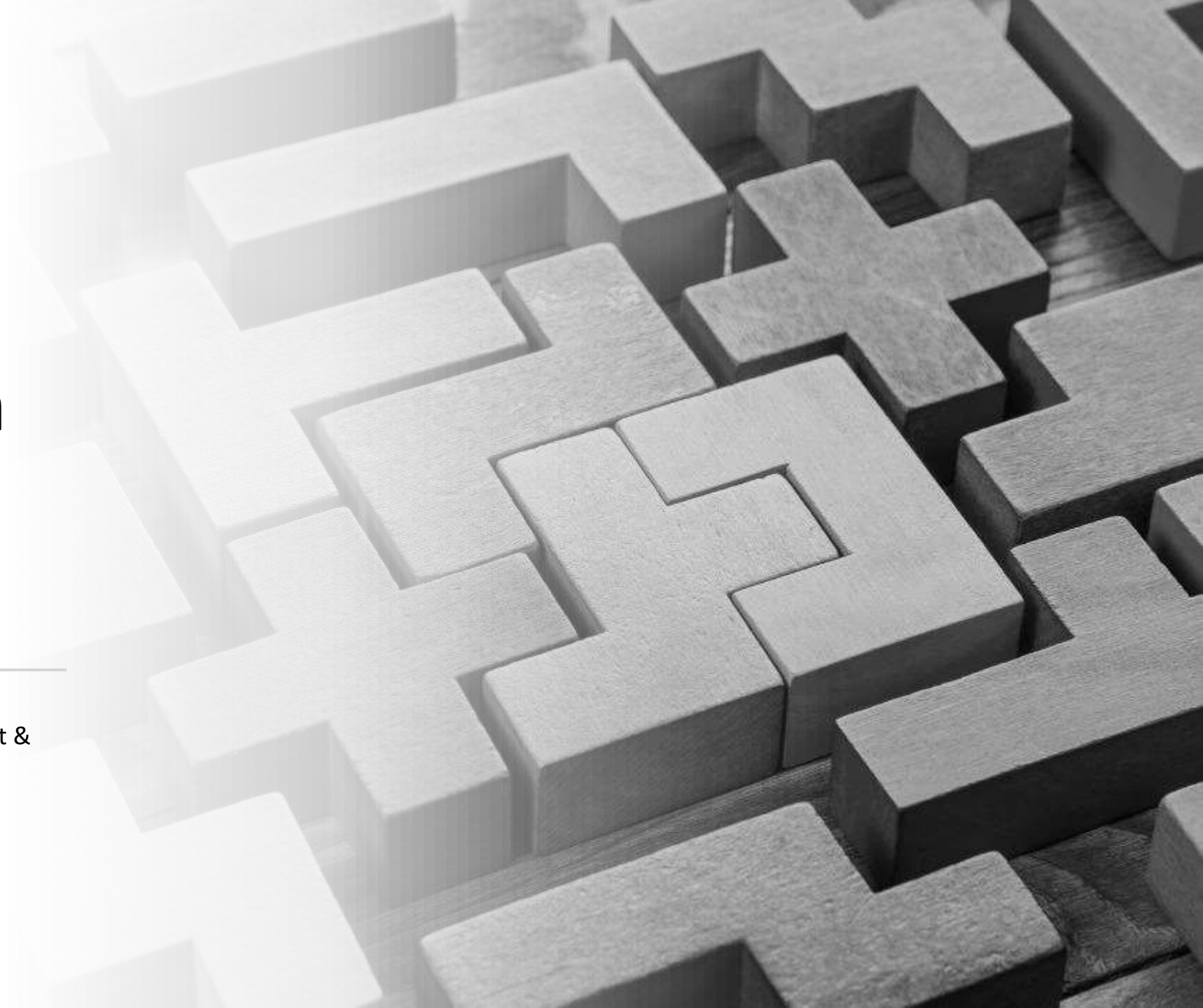
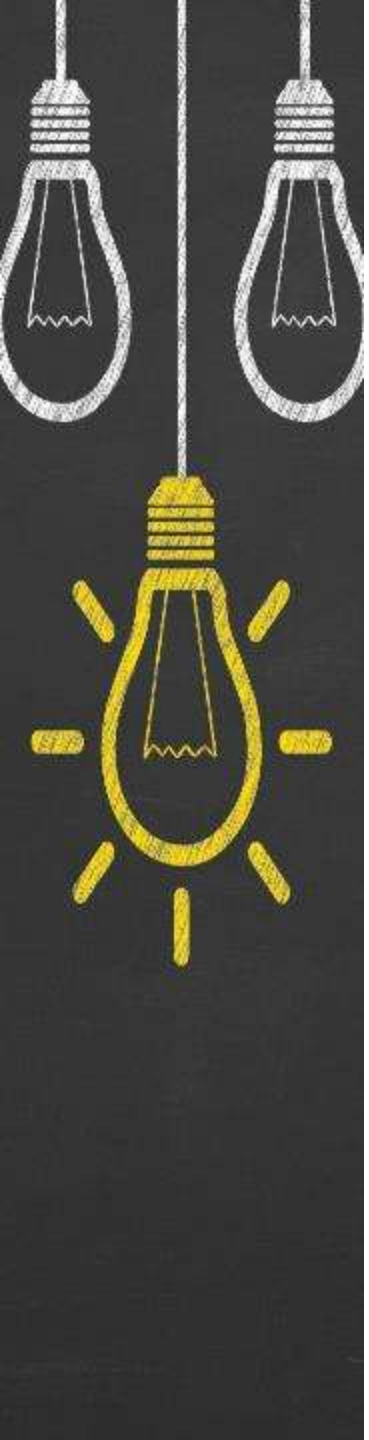
EATS

8 November, 2023





Role of Cognitive Skills in Aviation

- Cognitive skills are highly correlated with maintaining the ability to function effectively in task-saturated, high stimulus environments, while balancing worki memory, attention and motor response
- There is no doubt this describes a pilot's operating environment and provides th basis for situational awareness

- Pilots who have become accustomed to routine can often rely on habituation ar muscle memory and may not need to draw on their cognitive reserve regularly
- A deeper well of cognitive ability may only be required during novel or abnorma events

Identifying Cognitive Skills in Pilots

- Historically, simulator exercises have been used pre-hire to measure to ability of a pilot to perform tasks typical to the job, but this may not tell the whole story
- The Federal Aviation Administration uses cognitive testing to ensure pilots are medically fit for duty in a variety of circumstances
- Cognitive testing can also be used to identify pilots who may have more difficulty in training, and by extension, on the line
- For this reason, cognitive testing before hire is an effective way to identify potential issues
- As a consultant and analyst in the industry, I have worked with cognitive testing of pilots for more than 16 years

The Test: CNS VS

- In use since the early 2000s
- Clinical screening and research applications
  - Section and baselining for US Marines Special Forces
  - Used by Hospitals and Universities
- Demonstrated reliability and validity
  - Internal validity scales
- Established cognitive function domains
- Web-based, remote administration for testing, prior to bringing on site for interview
- Takes roughly an hour to complete

CNS Vital Signs®

Cognitive Testing

What are cognitive skills?

Pre-rational; time scale that does not allow for problem solving

High cognitive capacity allows pilots to respond appropriately to stimulus (hand flying) while still being able to access progressive, logical thought and utilize appropriate resources

Cognitive measurements

Reaction time in milliseconds

Correct responses

- Correct hits
- Correct passes

Incorrect responses

- Omission errors
- Commission errors

The study population

- Large US carrier, multiple fleets, wide and narrow body, domestic and long haul
- All First Officer positions
- 316 pilots who were tested and hired in 2022, all training events since: Initial Training and Continuing Qualification
  - 1-4 point scale for validation (final gate) event items
  - Overall event unsat
  - Repeated training
  - Special oversight program

Metrics of Interest

- Counts of 1 on the 4-point scale

"• *Qualification Standards are exceeded and not corrected back within Qualification Standards.*

• *Unsafe or crash **(in Evaluation only)**- can NOT be repeated- overall UNSAT*." – Training department guidelines

(pattern of low performance over different skills and different instructors)

- Unsatisfactory overall marks on the validation event

(unable to meet qualification standard for program)

- Combination of inclusion in the Oversight Program, a repeated training event, or an unsatisfactory overall grade

(quantifiable cost in program management, administration, simulator time, instructor pay, schedule disruption and risk of continued sub-standard performance)

Significant Cognitive Domains

Motor Speed:

- Speed-based, discrete motor response to stimulus

Processing Speed:

- Visual scanning, perception, visual memory and motor function

Psychomotor Speed:

- Speed-based, discrete motor response to stimulus AND
- Visual scanning, perception, visual memory and motor function

Sustained Attention:

- Long duration, progressive difficulty attention and memory test

Executive Function:

- Rule and category recognition, plus ability to recognize and adjust to randomly changing rules

Cognitive Flexibility:

- Rule and category recognition, plus ability to recognize and adjust to randomly changing rules AND
- Inhibition/disinhibition of impulses, direction of attention and increasing task complexity

Correlation coefficients and significance

	Count of 1	Unsat	OP+R+U
Psychomotor Speed	0.21***	0.12*	0.12*
Processing Speed	0.18**	0.15**	0.13*
Sustained Attention	0.12*	-	0.11*
Motor Speed	0.16**	-	-
Cognitive Flexibility	0.12*	-	-
Executive Function	0.12*	-	-

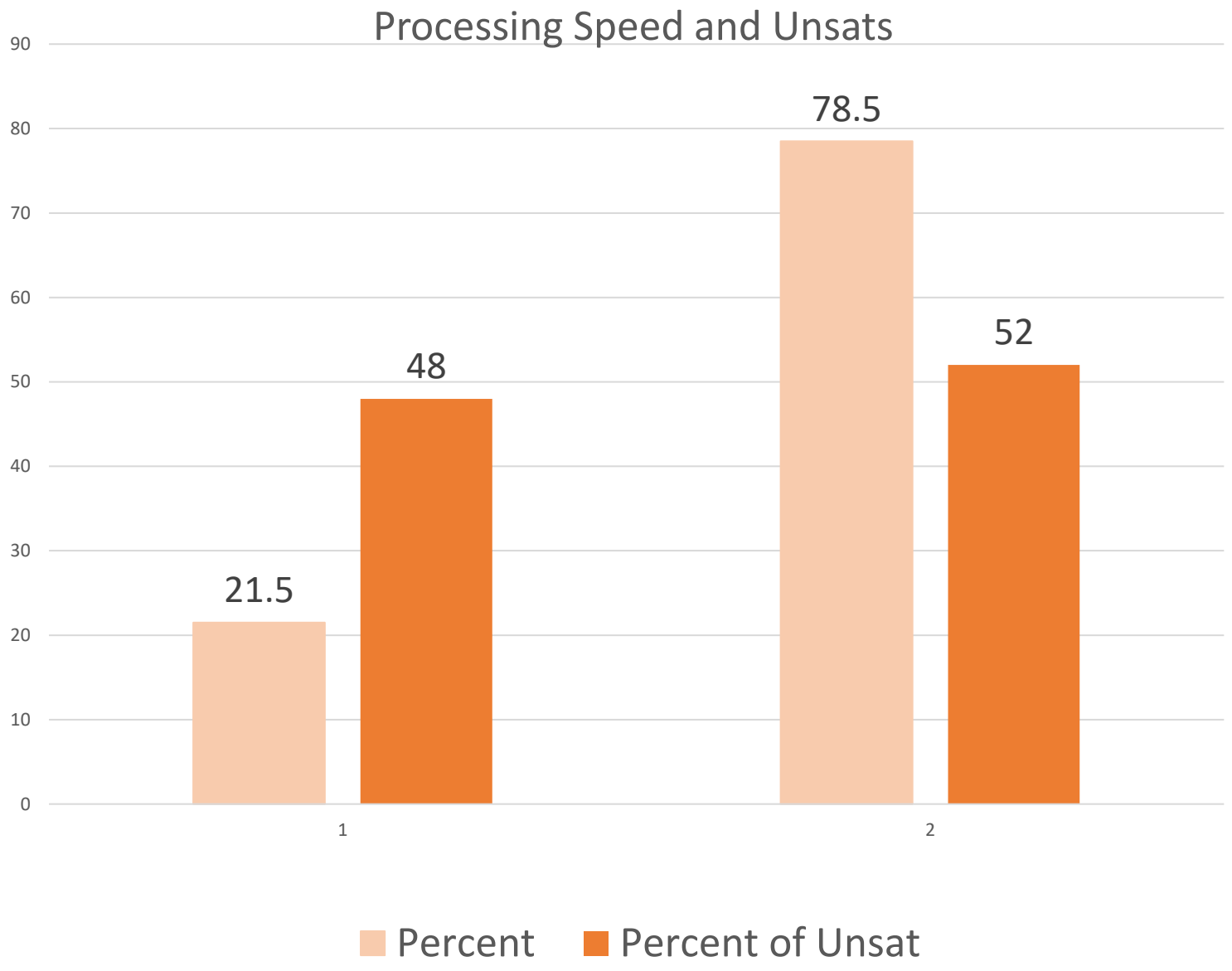
Significance Notations

*** p-value less than 0.001*

** p-value less than 0.01*

* p-value less than 0.05*

Processing Speed Domain And Training Unsats



Addition of Personality Characteristics: *Helps inform the cognitive picture*

Quintile	Position	Classification*
Bottom 20% N=4	5	True Positive
	11	True Positive
	50	True Positive
	59	True Positive
Top 80% N=5	131	True Positive
	155	True Positive
	196	True Positive
	209	True Positive
	221	True Positive

*True Positive indicates that extreme (greater than 2 SD) personality characteristics were found in testing and attitude problems were noted by the Training Department

Conclusion

- There tends to be an assumption when hiring at more experienced levels: *If you've gotten this far, you can fly*
- Routine flying may not represent capabilities of flying under more complex conditions
- The initial training environment provides some novelty
- Performance in this environment has a significant relationship to basic cognitive testing than can be performed pre-hire