

Improving Performance of Human Operators

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Overview of Talk

1. Primary Topic Area:

How to identify best performers at visual search and then train them to make them even better

2. Problem to Solve:

What tasks/measures provide *reliable* markers of elite performance?

3. How Problem is to be Solved:

- (a) Identify individual differences in search
- (b) Assess possible new TSA tool

4. So What?/What's the Point?:

Identifying predictive markers of search performance and leveraging mobile technology & Big Data

Overview of Project Team



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Two Broad Projects to Discuss Today

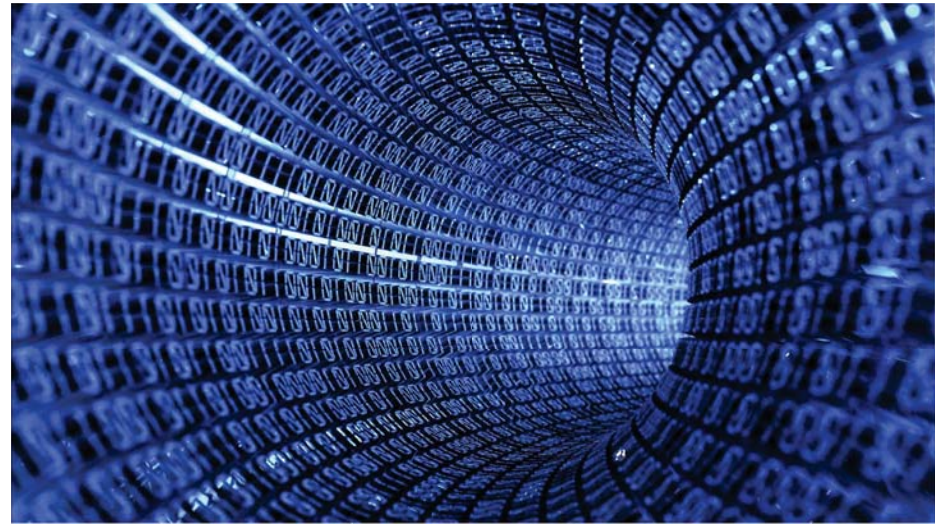
1. Individual Differences

- Characteristics of elite searchers
- Significant markers of performance



2. Mobile Technology Tool

- Use Big Data to examine search
- Design flexible tool for TSA



Testing Individual Differences in Two Labs

Duke University



Testing began 1/2010
900+ Unique Participants
1600+ Testing Sessions

Raleigh-Durham Airport



Testing began 11/2011
390+ Unique Participants
1300+ Testing Sessions

Individual Differences Assessments

Experiences & Preferences

General (age, gender, vision, etc.)
Ethnicity/Race
Personal information questionnaire
Video game playing questionnaire
General pastimes questionnaire
Media Multitasking questionnaire
Political & Religious Affiliation



Traits and Personality Assessments

Autism Spectrum Quotient
Jasper/Goldberg Adult ADHD Questionnaire
Eating Attitudes Test (EAT)
NEO Personality Inventory
Barratt Impulsivity Scale (BIS)
Positive and Negative Affect Schedule
Patriotism & Responsibility Scales



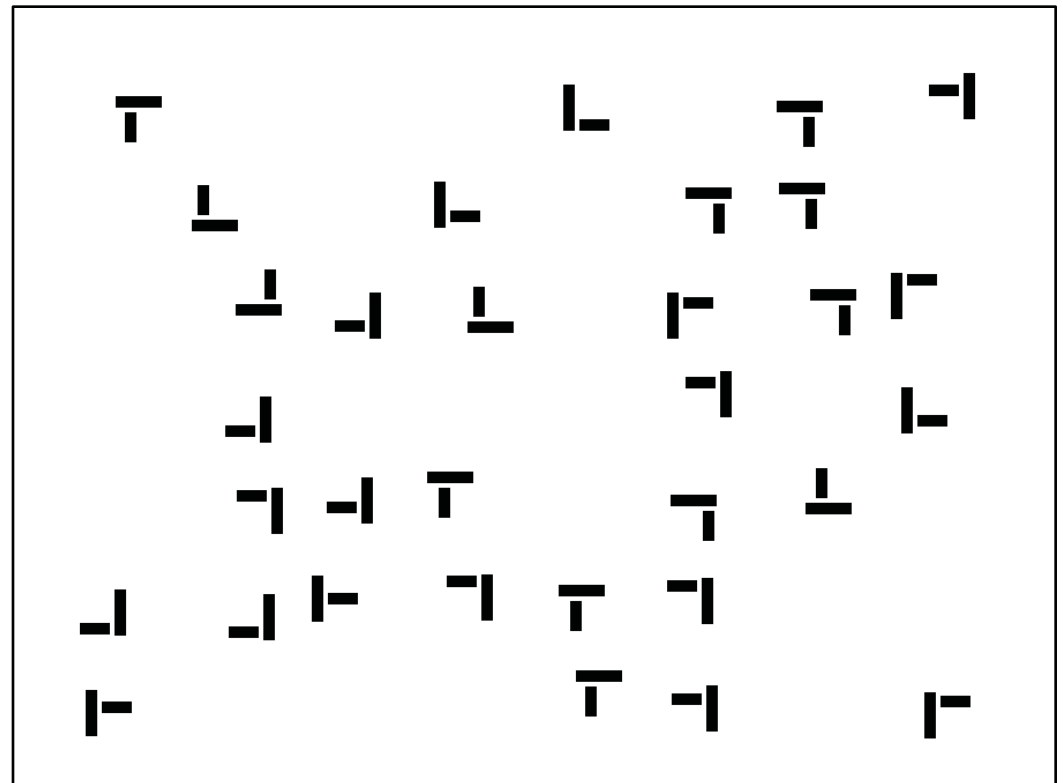
Abilities and Physical States

Edinburgh Handedness Inventory (EHI)
Visual Acuity
Frequency of Naps
Normal sleep patterns
Caffeine and nicotine consumption



Single-Target Visual Search Paradigm

- Target 'T' present on 50% of trials
- 0 or 1 target present per trial
- Set sizes of 8, 16, 24, 32
- Press one key for target present, and another key for absent
- 93 Duke participants
211 TSA Officers



Sample Individual Differences in Search

Basic Demographics

- Accuracy by gender/age

Action Video Game Playing

- Gamers vs. Non-gamers

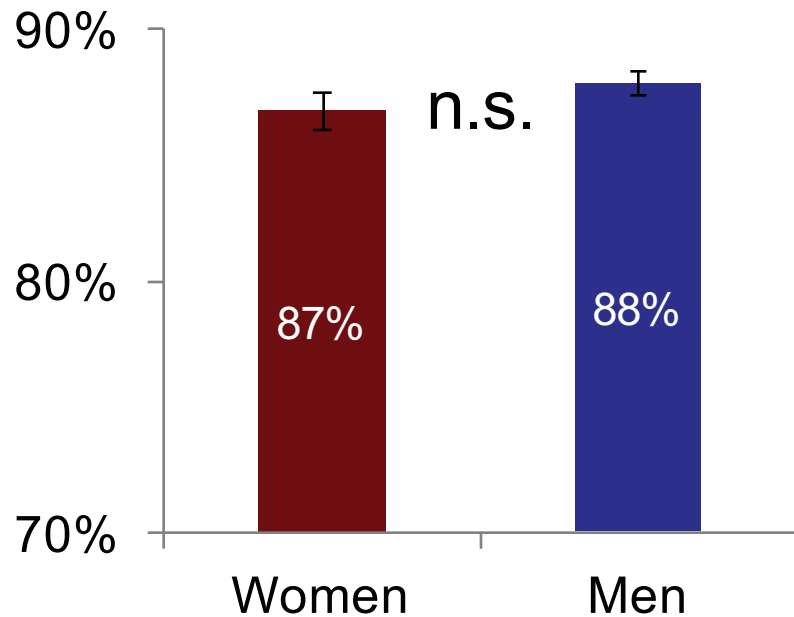
Conscientiousness

- Correlation across population

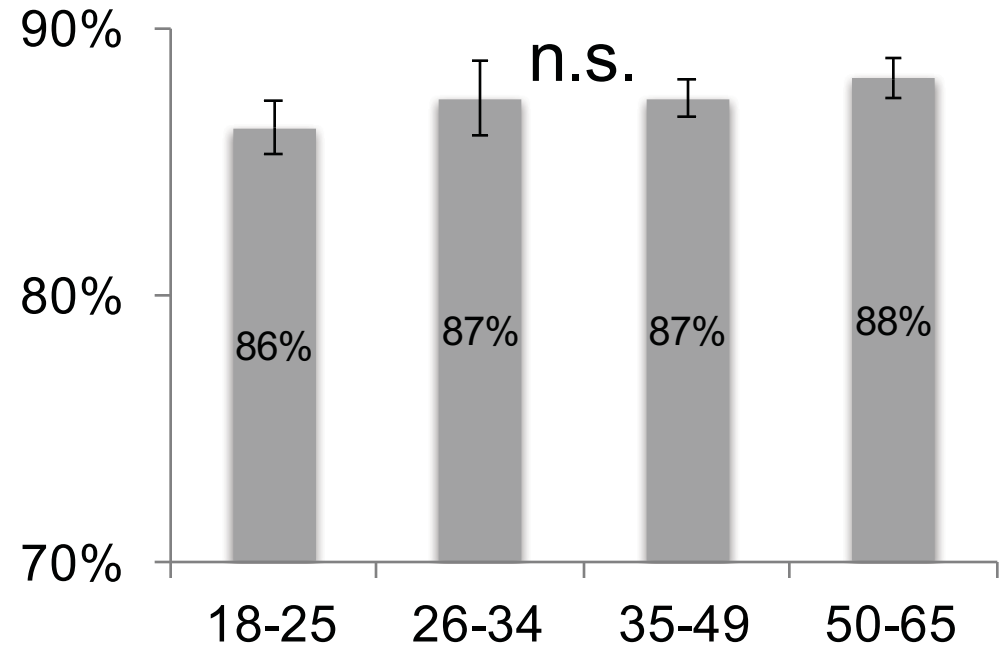
Individual Differences: TSA Officers

No Accuracy differences by basic demographics

Accuracy by Gender



Accuracy by Age



Video Game Playing & Visual Search



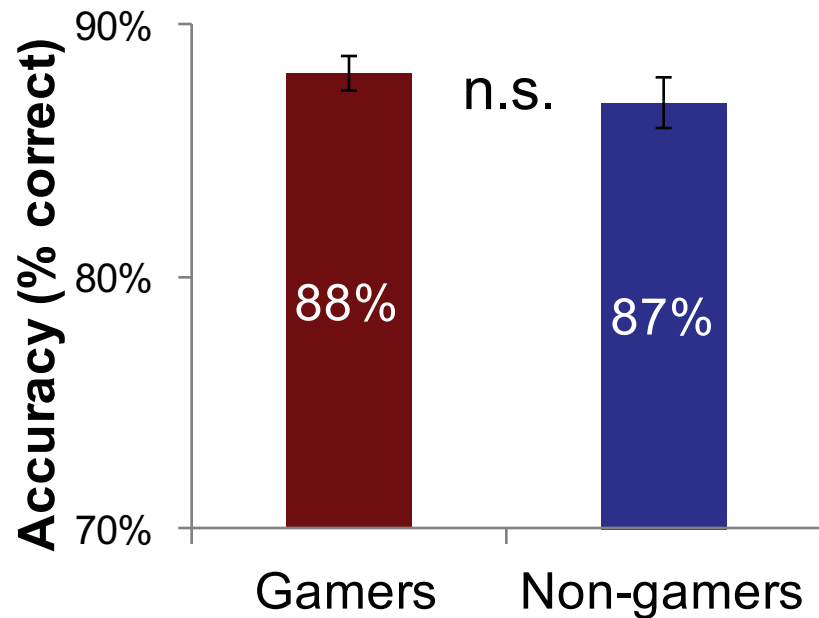
e.g., Castel, Pratt, & Drummond, 2005

Clark, Fleck, & Mitroff, 2011

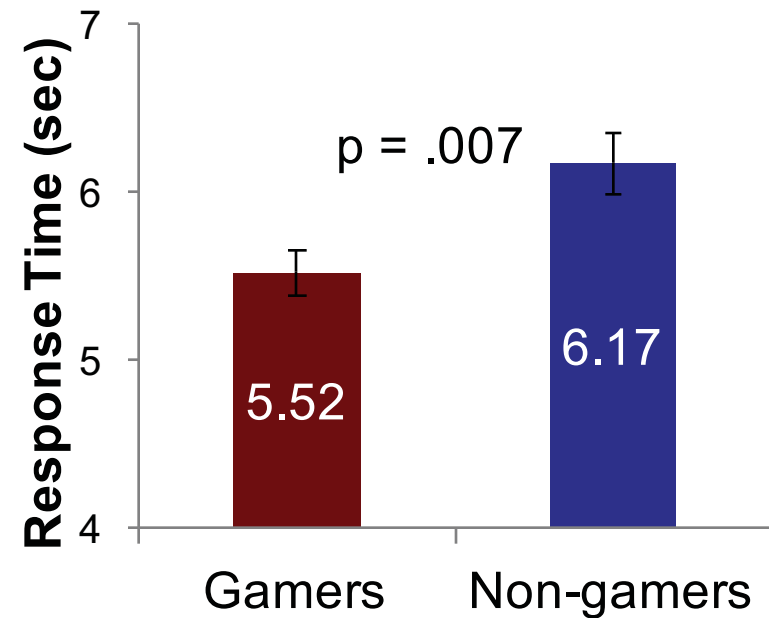
Hubert-Wallander, Green, Sugarman, & Bavelier, 2011

Individual Differences: TSA & Video Games

Accuracy

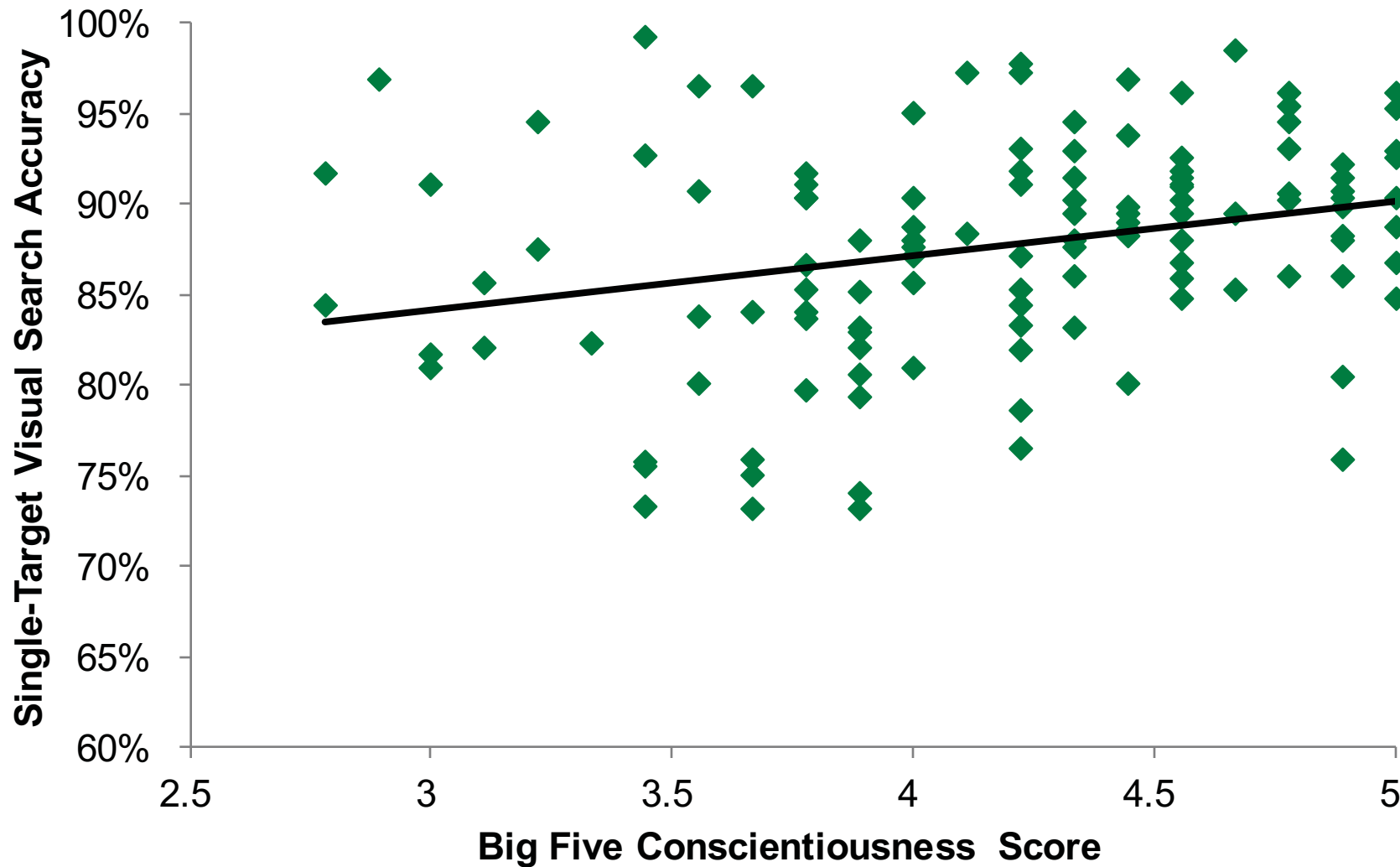


Hit Response Time



Gamers: N=50
Non-Gamers: N=89

TSA Officer Accuracy & Conscientiousness



$r = .28$
 $p = .001$

N=122

Two Broad Projects to Discuss Today

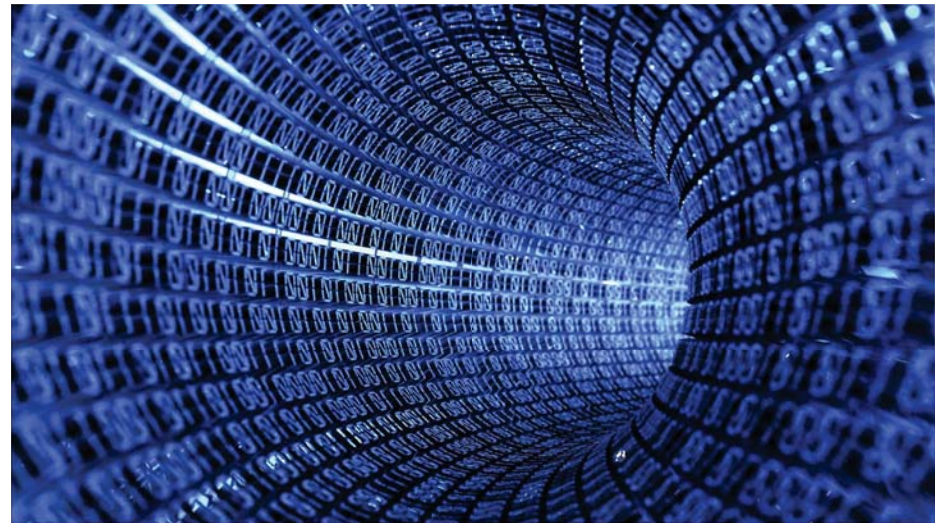
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2. Mobile Technology Tool

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Visual Search Data from Smartphone App



Airport Scanner App — Data Exporter

	<input type="button" value="Fetch day/session data"/>	<input type="button" value="Fetch bag/item data"/>	
Date range	<input type="text"/>	<input type="text"/>	
User Ids	<input type="text"/>	<input type="text"/>	
Airport	<input type="checkbox"/> TRAINEE <input type="checkbox"/> HONOLULU <input type="checkbox"/> LAS VEGAS <input type="checkbox"/> CHICAGO <input type="checkbox"/> ASPEN <input type="checkbox"/> LONDON		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Day	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Mission type	<input type="checkbox"/> Career <input type="checkbox"/> Challenge		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Replay	<input type="checkbox"/> No <input type="checkbox"/> Yes		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Rank	<input type="checkbox"/> TRAINEE <input type="checkbox"/> OPERATOR <input type="checkbox"/> PRO <input type="checkbox"/> EXPERT <input type="checkbox"/> ELITE		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Day Complete Status	<input type="checkbox"/> COMPLETED <input type="checkbox"/> SECURITY BREACH <input type="checkbox"/> OUT OF TIME		<input type="button" value="Select All"/> <input type="button" value="Select None"/>
Bag types	<input type="checkbox"/> BRIEFCASE		

Airport Scanner “Big Data” Numbers

As of 5/11/2016

>9.9 million installs

>2.6 billion trials

One Main Goal: Predict Later Success

Collaborators:



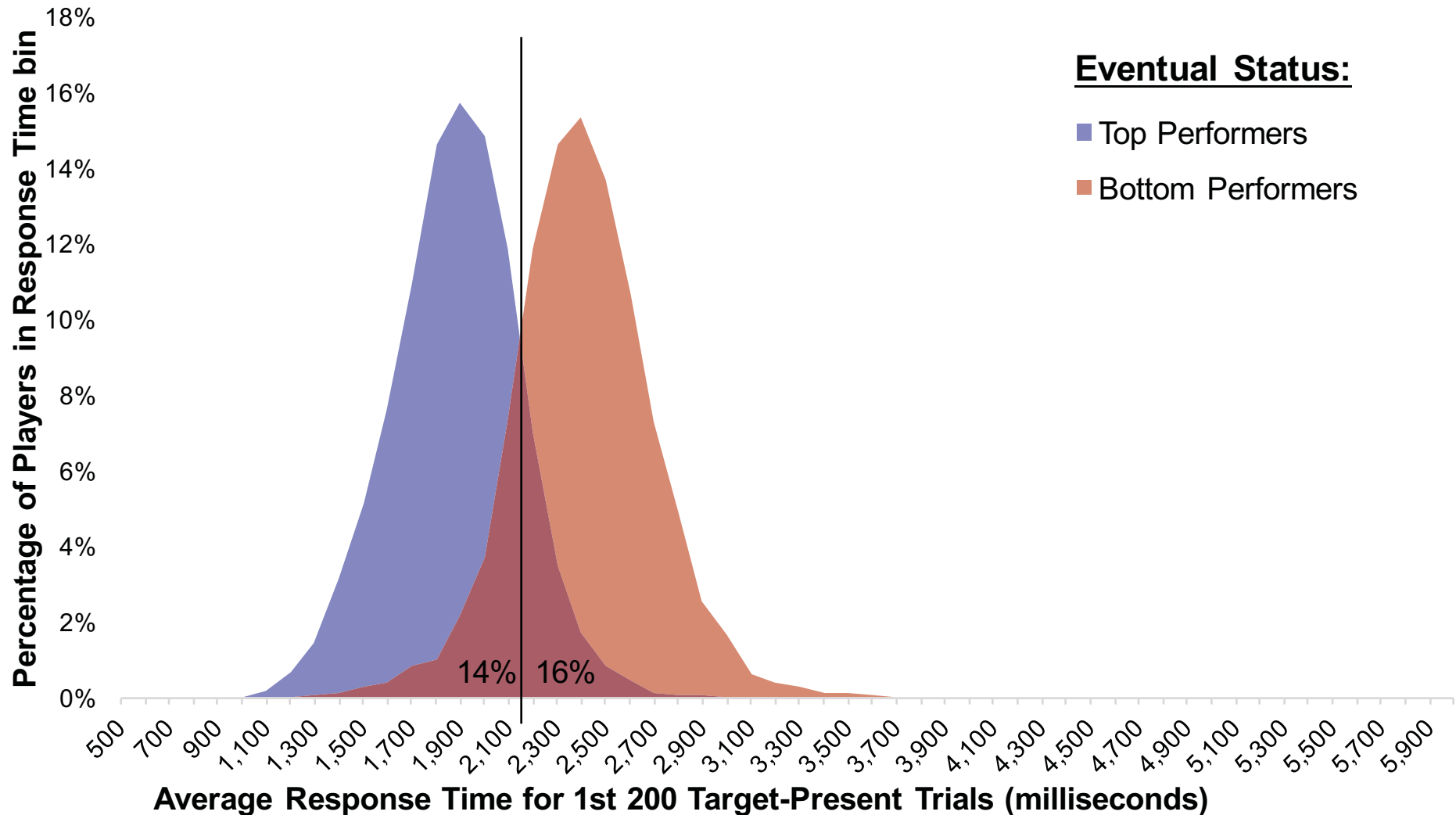
Justin Ericson



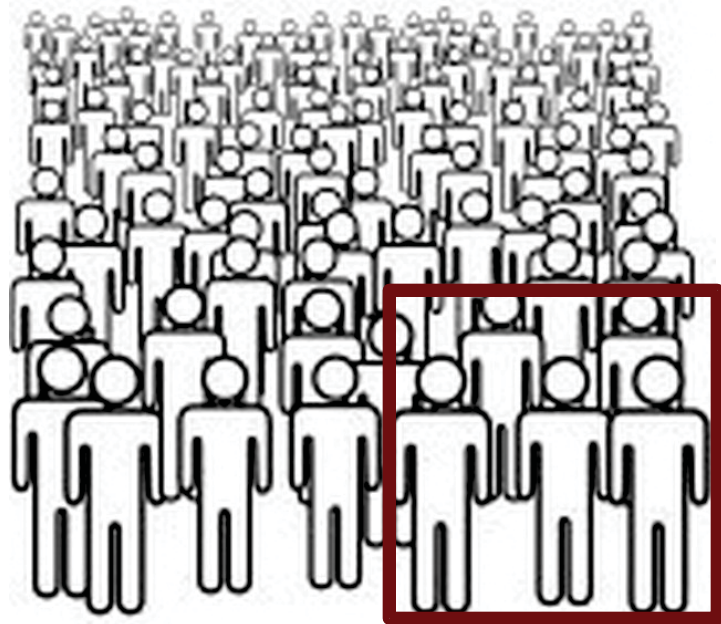
Dwight Kravitz

Early Performance Predicts Later Success

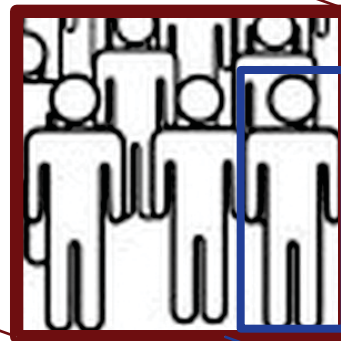
**Knowing a user's early performance response time is
~85% predictive of their eventual search capabilities**



Predicting Super-Performers from Early Data



330,000



6,326



29



Predicting Super-Performers from Early Data

Use accuracy and response time from 1st 100 trials to predict later success

Split initial accuracy & response time performance into *quartiles*

Chance
Distribution

	Low Accuracy	High Accuracy
Fast Response Time	6.25%	6.25%
Slow Response Time	6.25%	6.25%

Actual Distribution of 29
super-performers

	Low Accuracy	High Accuracy
Fast Response Time	0%	51.72%
Slow Response Time	0%	6.89%

Thanks!

Army
Research
Office



Institute for Homeland
Security Solutions



Department of
Homeland Security



Stephen
Adamo



Adam
Biggs



Matthew
Cain



Kait
Clark



Elise
Darling



Emma
Wu Dowd



Justin
Ericson



Mat
Fleck



Jonathan
Winkle

