6-9-2023

The Effects of Fatigue and Shift Work on Visual Search and Object Tracking Tasks in TSA Officers and Air Traffic Controllers

Margaret Colwell
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June 9, 2023, 12:00 – 2:00 PM, U.S. Capitol Visitor Center, Room H-122
Washington, D.C.

WORLDWIDE | DAYTONA BEACH | PRESCOTT CAMPUS

OPTIMIS: OPTIMIZING HUMAN PERFORMANCE IN THE AIR TRANSPORTATION SECTOR BY INTEGRATING HUMAN FACTORS INTO HOMELAND SECURITY DETERRENCE AND DETECTION PROCEDURES AND TRAINING: SYSTEM INTERFACES AND BEHAVIORAL SCREENING AT SECURITY CHECKPOINTS

UNDERGRADUATE RESEARCH COLLABORATIVE GRANTS PROGRAM

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PROGRAM

12:00 PM - 12:10 PM: Opening Remarks: OPTIMIS Project and the Undergraduate Collaborative Research
Dean Alexander Siedschlag & Dr. Cihan Aydiner

12:10 PM - 12:30 PM: The Effects of Fatigue and Shift Work on Visual Search and Object Tracking Tasks in TSA Officers and Air Traffic Controllers
Margaret Colwell, ERAU Prescott Campus

12:30 PM - 1:20 PM: Behavioral Indicators of Deception: Recommendations for Training of Security Professionals
Amore Hunter, Madison Werner & Dr. Christina M. Frederick, ERAU Daytona Beach Campus

1:20 PM - 1:30 PM: Break

1:30 PM - 1:50 PM: Developing Critical Thinking and Effective Communication (CTEC) Skills to Support the TSA Workforce in Critical Infrastructure Protection
Teeunandra Forde & Dr. Cihan Aydiner, ERAU Worldwide Campus

1:50 PM - 2:30 PM: End-user Requirements for Subsequent Research, Discussion & Closing Remarks

OPENING REMARKS:
OPTIMIS PROJECT AND THE UNDERGRADUATE COLLABORATIVE RESEARCH

Dean Alexander Siedschlag

Dr. Cihan Aydiner

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Aeronautical University

OPTIMIS PROJECT

Problem: In today's persistent threat environment, strengthening the airport security screening checkpoint with its holistic human, social, and technological ecology in mind is an ongoing challenge.

Goal: This project addresses human performance optimization in commercial air transportation by integrating human factors principles into homeland security deterrence and detection tasks, procedures, training, and technology interfaces at security checkpoints.

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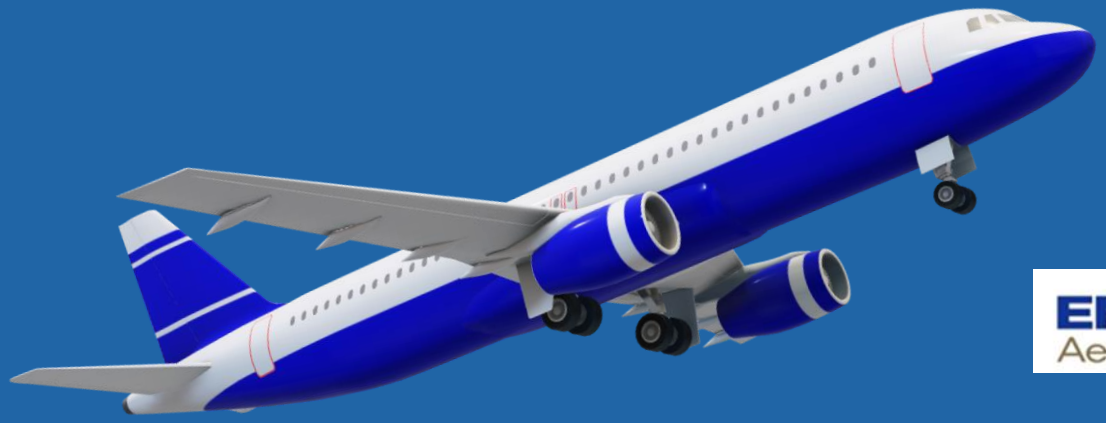
PRESCOTT CAMPUS | COLLEGE OF ARTS & SCIENCES

The Effects of Fatigue and Shift Work on Visual Search and Object Tracking Tasks in TSA Officers and Air Traffic Controllers

Margaret Colwell



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Fatigue

- **Physical** (caused by sleep deprivation, exertion, illness and poor nutrition)
- **Mental** (intense concentration, or rapid/complex information processing, demanding mental situations)
- **Emotional** (wearing effects of working under trying conditions)

OVERVIEW AND CONTEXT

(WALDOCK, PERSONAL COMMUNICATION, MARCH,2023)

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Effects

- Decreased cognitive function
- Impairs ability to perform tasks requiring concentration, dexterity, and high-level intellectual processes
- Decreased vigilance, issues recalling information

OVERVIEW AND CONTEXT

(WALDOCK, PERSONAL COMMUNICATION, MARCH,2023)

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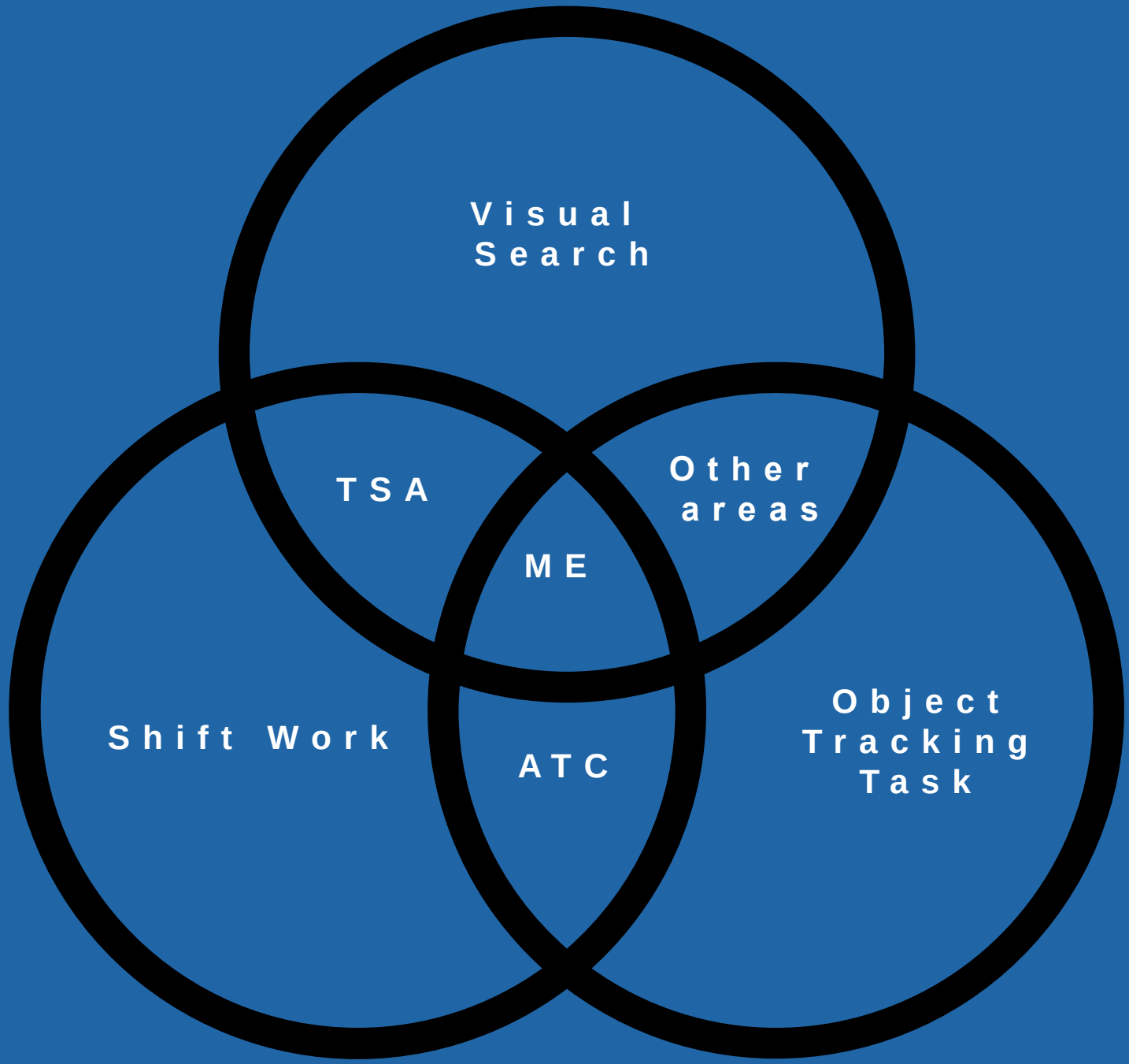
Visual Search
TSA
Other areas
ME
Shift Work
ATC
Object Tracking Task

Shift work

- Division of working hours being broken up into sections, rotating in ATC

Types of Shift Work

- Full-Time
- Part-Time
- Flexible
- Rotating Shift Schedules
- Split Shift
- On-Call
- Compressed Schedules

OVERVIEW AND CONTEXT

Indeed. (2023). Employee work schedules: A manager's guide - indeed. https://www.indeed.com/hire/c/info/types-of-work-schedules

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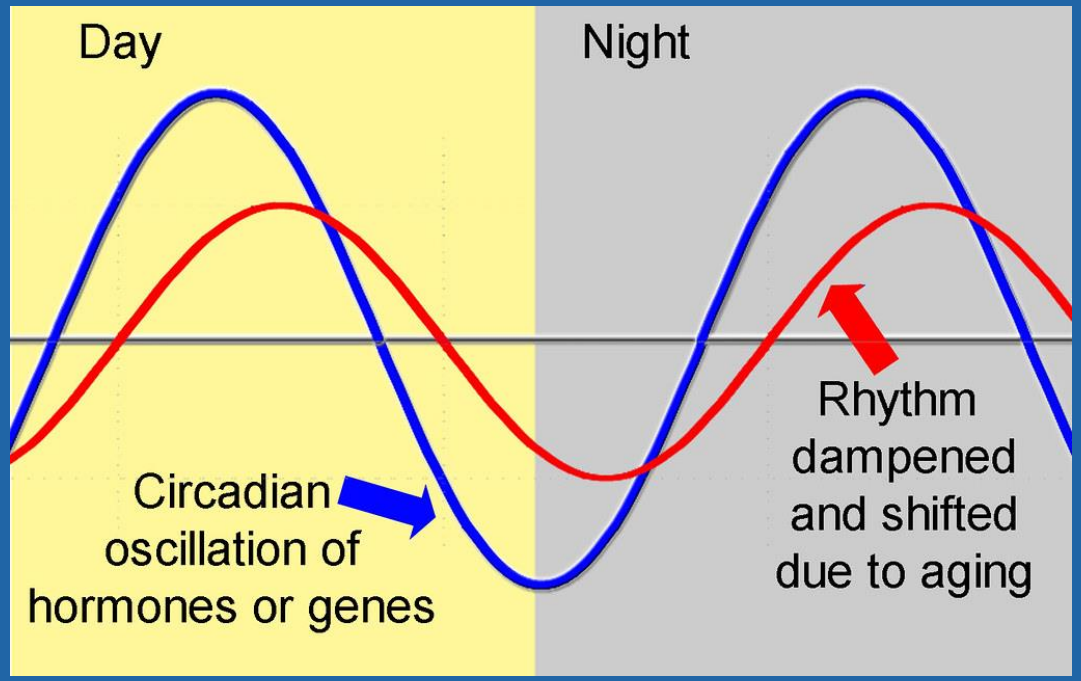

Circadian Rhythms

Body's natural sleep wake cycle, associated with proteins, light cycles, and typical periods of alertness

(Waldock, personal communication, March,2023; Arnholt, personal communication, February,2020)

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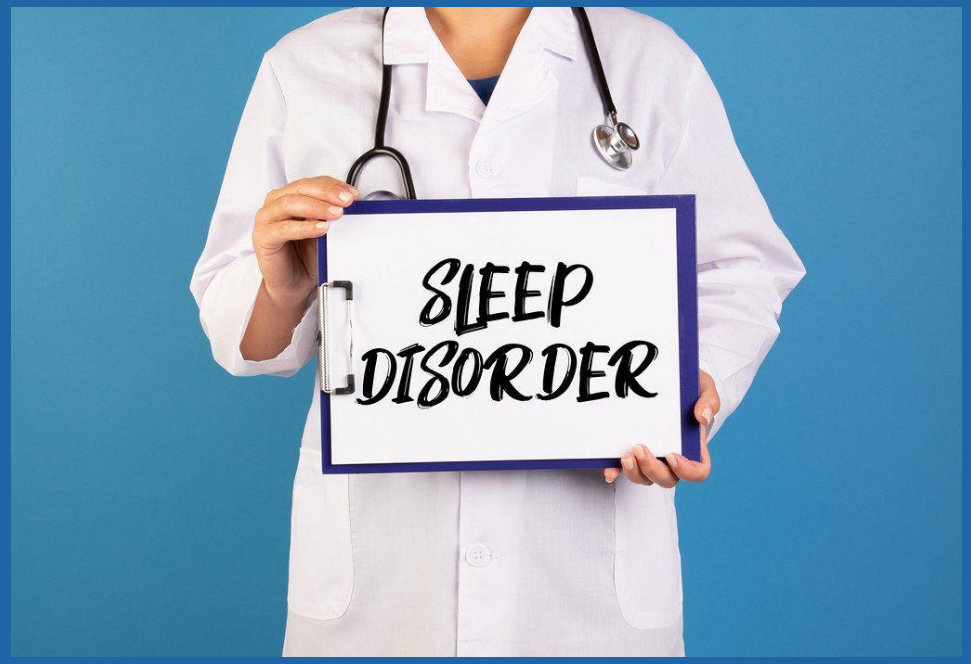
Disorders

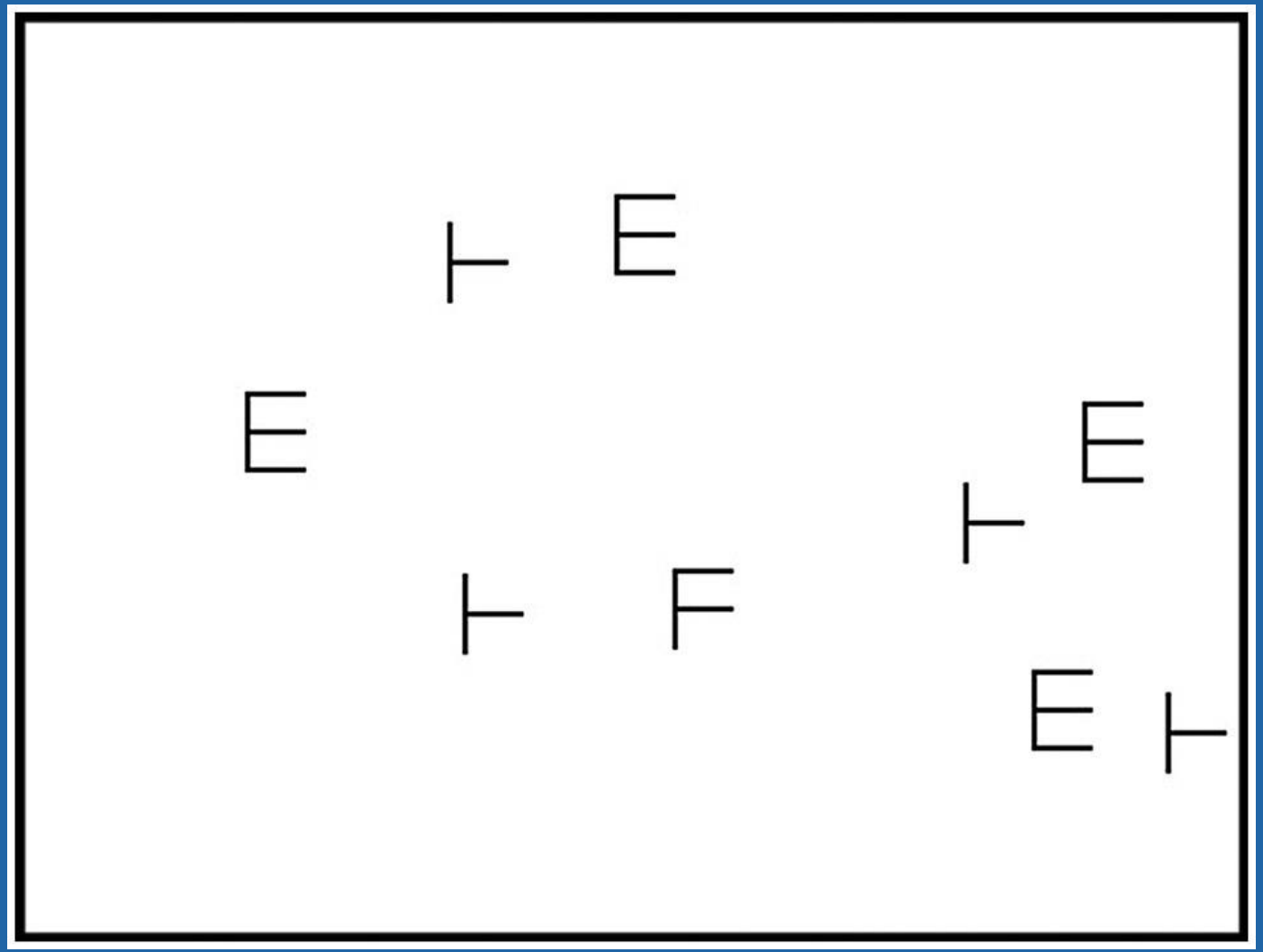
1. Delayed sleep
2. Shift work disorder
3. Irregular sleep-wake cycles
4. Non 24-hour sleep-wake syndrome



(Waldock, personal communication, March,2023; Arnholt, personal communication, February,2020)

Visual search task

- Perceptual task using attention to scan an environment for a feature or item among other potential distractors



(Danek, Personal communication, October,2022)

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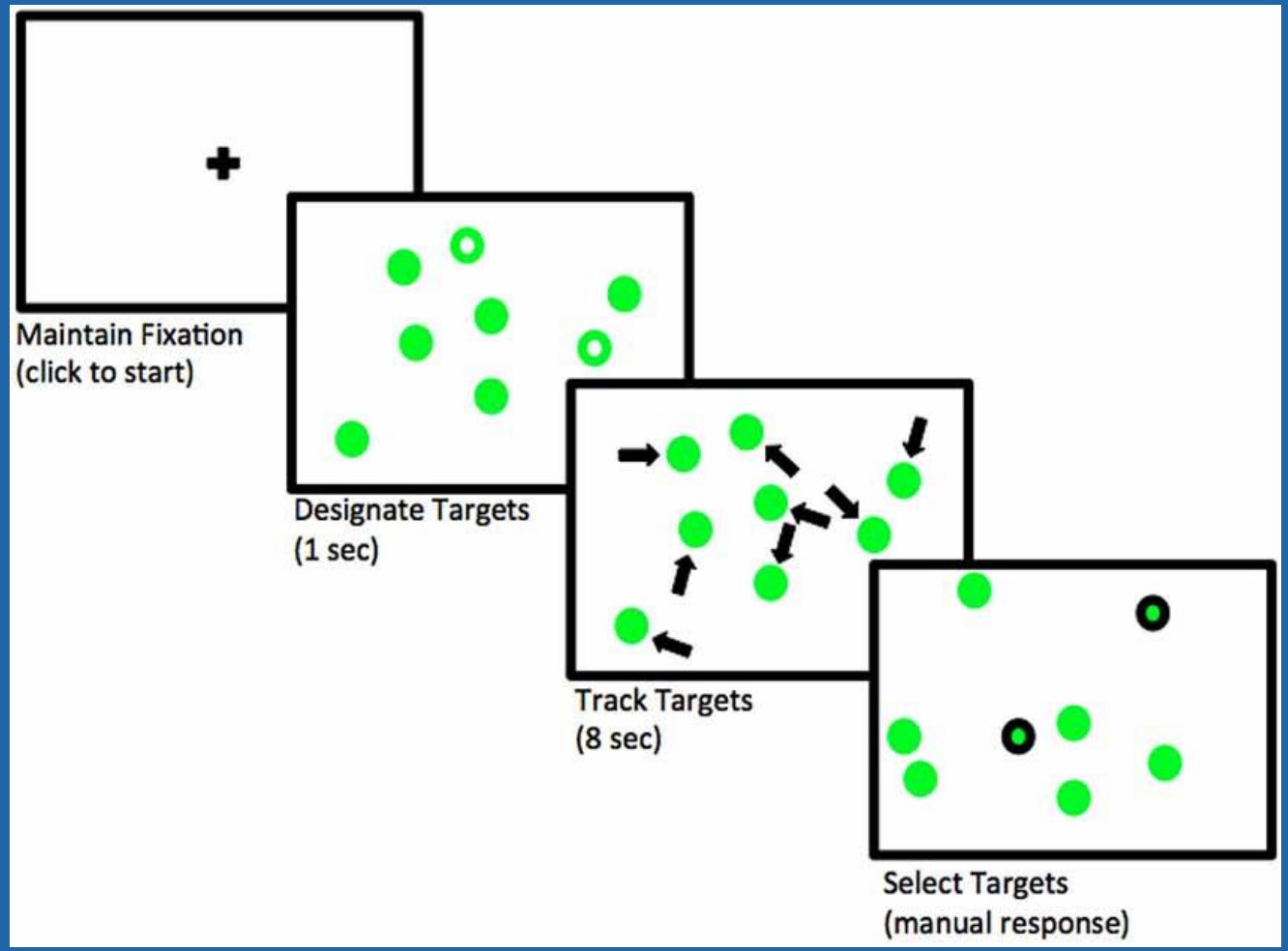
Object tracking task

- Perceptual task using attention to scan and follow one item among other potential distractors



(Danek, Personal communication, October,2022)

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Firefighters

- Study looking at sleep quality
- Subjectively more tired
- Critical flicker fusion frequencies
- Temperatures showed had a lower body temperature
- Performed worse, rotating schedule

H Takeyama , T Itani , N Tachi , O Sakamura , K Murata , T Inoue , T Takanishi , H Suzumura & S Niwa(2005) Effects of shift schedules on fatigue and physiological functions among firefighters during night duty, Ergonomics, 48:1, 1-11, DOI: 10.1080/00140130412331303920

Driving

- We can see the workload reflected by mental tasks
- Reduced situational awareness
- Relevant stimuli is favored over irrelevant stimuli
- Targets are looked at less frequently when preforming mental task

Recarte, M. A., & Nunes, L. M. (2003). Mental Workload While Driving: Effects on Visual Search, Discrimination, and Decision Making. Journal of Experimental Psychology. Applied, 9(2), 119–137. https://doi.org/10.1037/1076-898X.9.2.119

Speed- Accuracy Trade-Off

Professional		Non - Professional
Speed-Accuracy Trade-Off		Speed-Accuracy Trade-Off
Speed	→	Speed
Accuracy	→	Accuracy
Consistency	←	Consistency
Age	↔	Age

Adam T. Biggs, Matthew S. Cain, Kait Clark, Elise F. Darling & Stephen R. Mitroff (2013) Assessing visual search performance differences between Transportation Security Administration Officers and nonprofessional visual searchers, Visual Cognition, 21:3, 330-352, DOI: 10.1080/13506285.2013.790329

Visual Search Studies

1. Efficiency of working with assistive technologies

2. Implications of working in a collaboratively

3. BDO vs. TSO

Yamani, Y., Neider, M. B., Kramer, A. F., & McCarley, J. S. (2017). Characterizing the efficiency of collaborative visual search with systems factorial technology. *Archives of Scientific Psychology*, *5*(1), 1-9. https://doi.org/10.1037/arc0000030

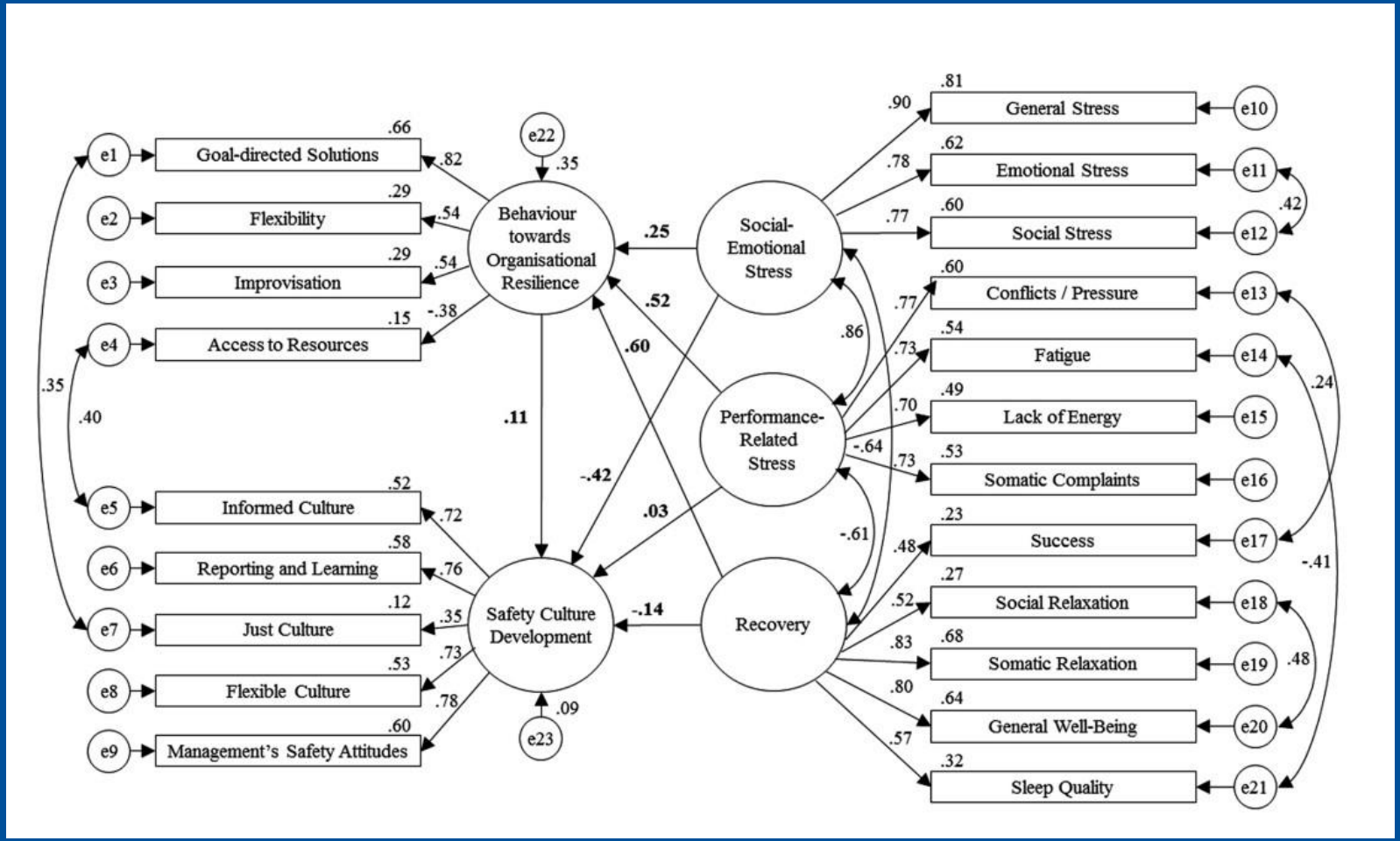
Spain, R. D., Hedge, J. W., & Blanchard, J. K. (2017). Examining Predictors of Visual Search Success in Transportation Security Officers and Behavior Detection Officers. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *61*(1), 1308–1312. https://doi.org/10.1177/1541931213601809

Air Traffic Control Studies

1. Indonesian Air Traffic Controls Study

2. Rapid Counterclockwise Shift Rotation

3. Safety Culture, Resilient Behavior and Stress in ATC

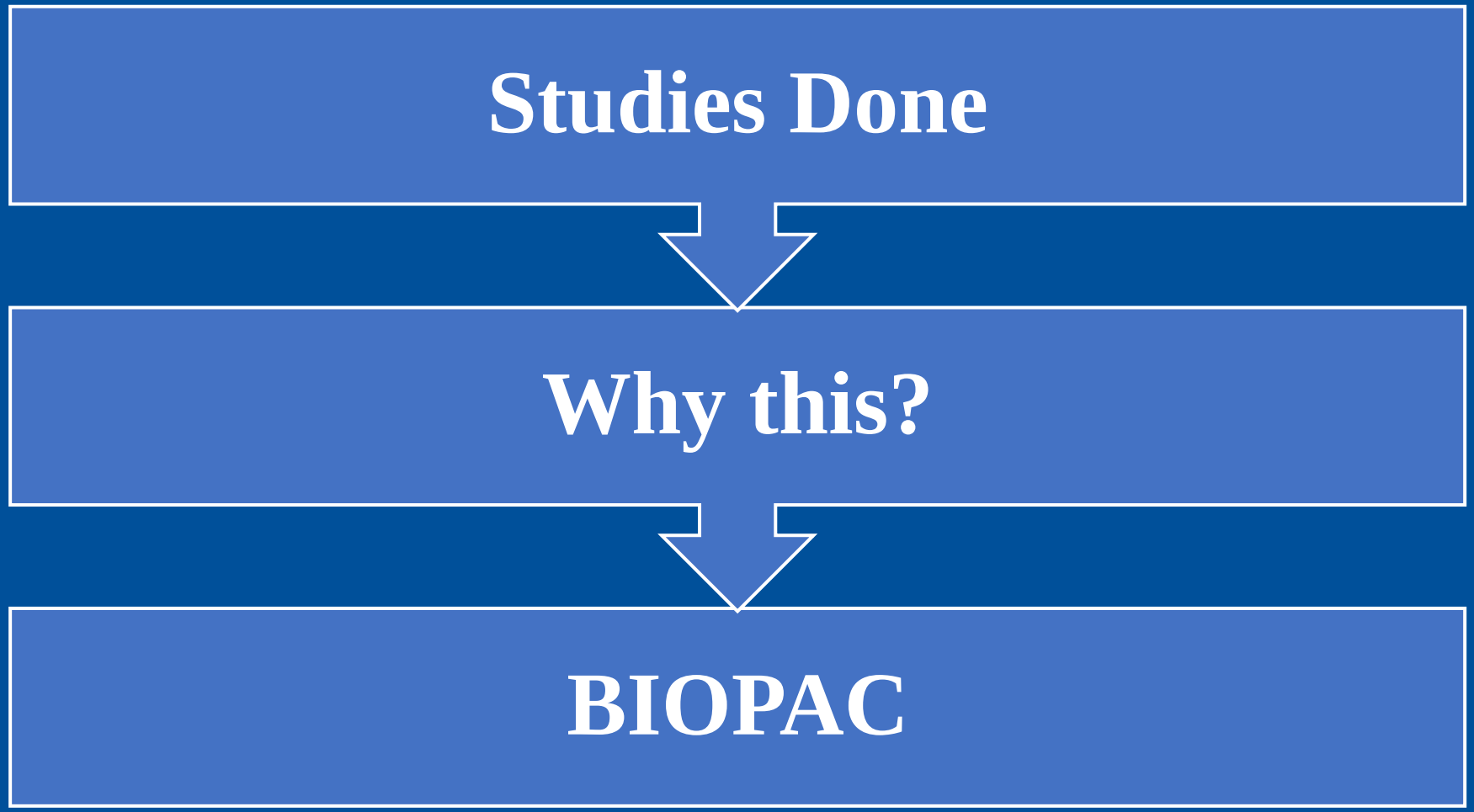


Venesia, Z., & Widyanti, A. (2019). Compatibility between Shift Work and Chronotype in Indonesian Air Traffic Control' Workers: View of Performance and Mental Workload. *Journal of Physics. Conference Series*, *1175*(1), 12191–. https://doi.org/10.1088/1742-6596/1175/1/012191

Signal, T. L., & Gander, P. H. (2007). Rapid Counterclockwise Shift Rotation in Air Traffic Control: Effects on Sleep and Night Work. *Aviation, Space, and Environmental Medicine*, *78*(9), 878–885.

Schwarz, M., Kallus, K. W., & Gaisbachgrabner, K. (2016). Safety Culture, Resilient Behavior, and Stress in Air Traffic Management. *Aviation Psychology and Applied Human Factors*, *6*(1), 12–23. https://doi.org/10.1027/2192-0923/a000091

Continuing research



Questions or Comments?

Behavioral Indicators of Deception: Recommendations for Training of Security Professionals

Amore Hunter, Madison Werner
Faculty Advisor: Christina M. Frederick

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One day in the airport…..

- I watched as a young woman in her 20's came into my gate area. She was carrying a medium size canvas duffel. She looked around for about 30 seconds, and then walked to a vacant seat farthest from the boarding gate, and away from other travelers. She kept repeatedly touching and rubbing the bag, and clasped it tightly to her. She sat rigidly, staring straight ahead, blinking frequently.

  - Is this behavior odd for a 20 year old woman?
  - Is it deceptive?
  - Is it a security threat?
  - How do we assess it?
  - Who should assess it?
  - What would you do about it?

The UK Approach: See it, Say it, Sorted

See it, Say it, Sorted

- https://www.youtube.com/watch?v=4U8OX75kV0g

This approach works when:

- **Security Personnel are also trained in the use of recognizing deception and security threats**
- **The general public is aware of legitimate behaviors that may constitute deception**
- **It's taken seriously by everyone**

- ***Applying this in the US could be a challenge due to the size and volume of travelers processed across transportation environments on a daily basis***

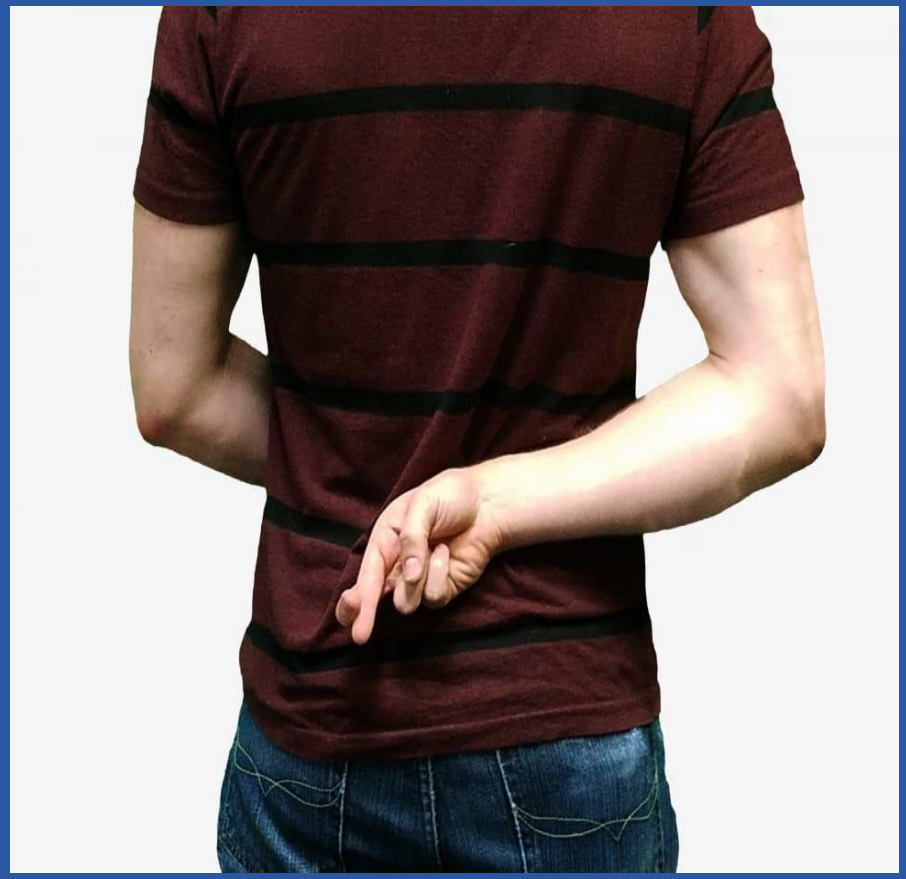
Current Project: Focusing on Deception

- Short term goal:
  - Review of the current science across disciplines to extract scientifically valid indicators of deception
  - Extract those that can be reliably observed and trained for
  - Create a catalog of those indicators, including descriptions, referer
    limitations
- Long term:
  - Test the indicators to independently validate them (optimally)
  - Publish a training article based on substantiated results

- For whom?
  - Security Professionals across Transportation Domains
  - Security Professionals in public venues - schools, stadiums, the
  - The traveling public - safety and security is everyone's busines

Today's Presentation

- Defining Deception
- Indicators of Deception
- The Current Project
- Why is it important?



What is deception?

Is it just lying? Is it only answering what is asked and nothing more?

- An act that is intended to foster in another person, a belief or understanding that the deceiver considers false. (Galasiński, D, 2000).

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What is the purpose of deception?

- Based on experience individuals discover truthfulness leads to personal losses and deception leads to personal gains.
- Therefore, it appears that self-interest incentives play a specific role in the discovery of deception (Reyes-Jaquez & Echols, **2015**).

What is the difference between behavioral and physiological indicators of deception?

Behavioral

- Observable characteristics associated with deception.
  - ➢Gaze aversion (eye contact)
  - ➢Speech errors
  - ➢Nervousness (fidgeting)

Physiological

- The finding that conflict and emotional behavior frequently results in noticeable physiological changes.
  - ➢Respiratory and heart rates increase
  - ➢Start to sweat
  - ➢Mouth goes dry
  - ➢Voice can shake

(Vrij, 2000)

Why is it important to train screeners and frequent flyers to observe behaviors?

1. Detect threats (to a flight or other passengers) early.
2. Be able to intervene before the situation escalates.
3. To keep travelers secure and safe

Indicators of Deception

What are indicators?

Indicators

traits or behaviors that employers and managers can use to assess the competencies of their employees

Facial Action Coding System (FACS)

"A set of facial movements that correspond to a certain emotions" (Adelson, 2003)

These techniques can be used and trained in certain environments such as:

- Security Guards
- Counter-terrorism Agents
- Police Interrogators

When these techniques are combined with vocal cues and speech patterns it can lead to a 90% success rate

Behavioral Indicators

Cognitive Complexity Theory:

- Lying is a more cognitively demanding task than truth telling

Emotional Theory:

- There are 3 emotions associated with lying
- The body gives off an unconscious signal when lying (Leakage)

Transactive Memory Approach:

- 2 co-conspirators or suspects depending on each other to tell the correct story
- Memories from another person may trigger memories of events in the other person, leading them to fill the story in for each other

Vocal Indicators

Speech Patterns	"Um I was just um walking through security and um I forgot my bags at the check in desk."
Unnecessary Pauses	"I was on my way home…..but then I stopped by my house"
Restatement of Question	"Did I do it? Of course I did not do it!"
Avoiding "I" Statements	"The vase got broken" versus "i broke the vase"
Wrong word choice	"I did not do it' versus "I didn't do it"

Body and Muscular Movements

Gaze Aversion	No eye contact or too much eye contact to avoid cognitive overload
Increase in blinking	liars tend to blink quicker than the average person
Foot and leg movements	The tendency to move around and fidget more when you are being dishonest

Current Project

- Short term goal:
  - Review of the current science across disciplines to extract scientifically valid indicators of deception
  - Extract those that can be reliably observed and trained for
  - Create a catalog of those indicators, including descriptions, references, training methods and limitations
- Long term:
  - Test the indicators to independently validate them
  - Publish a training article based on substantiated results

- For whom?
  - Security Professionals across Transportation Domains
  - Security Professionals in public venues - schools, stadiums, theaters, etc
  - The traveling public - safety and security is everyone's business

Techniques to Detect Deception: Template Information

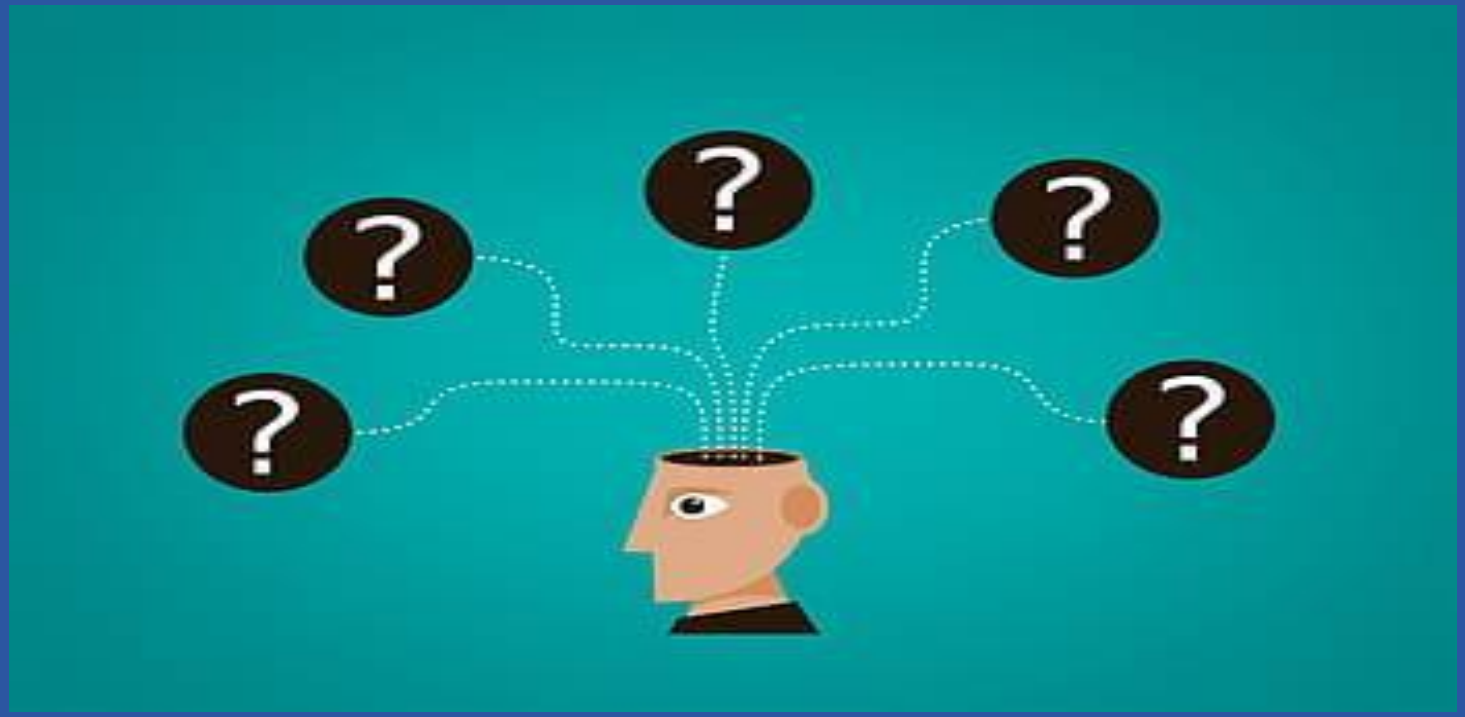
- Indicator of Deception
  - Behavioral/Psychological or Physical?
  - Other:
- Description
- Reference Link or Citation
- Training Method
- Pros
- Cons
- When would this technique be useful?
  - For whom?

Summary

What will this project add to existing knowledge?

- It provides a timely update to existing techniques
- Based on proven science
- Non-classified information accessible to a wider audience
- Can be easily updated to remain current as knowledge evolves

Thank you!



BREAK

1:20 pm – 1:30 pm

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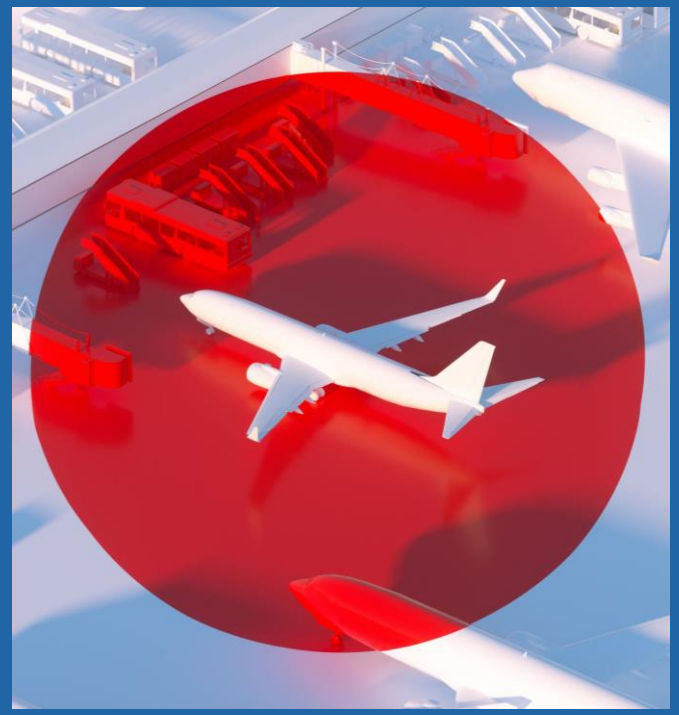

Developing Critical Thinking and Effective Communication (CTEC) Skills to Support the TSA Workforce in Critical Infrastructure Protection

Teeunandra J. Forde
Faculty Advisor: Cihan Aydiner

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United States Department of Homeland Security. (n.d.).
https://www.oig.dhs.gov/sites/default/files/assets/2019-04/OIG-19-35-Mar19.pdf

Transportation Security Administration (TSA)

Human error remains the primary cause of aviation accidents.

OFFICE OF INSPECTOR GENERAL
Department of Homeland Security

guidance on the applicant ranking process. As a result, TSA airport officials may not be identifying and hiring the most highly qualified individuals for TSO positions.

Competency Tests and Structured Interview Questions Do Not Fully Assess TSO Applicants

To hire more qualified applicants, TSA could enhance the current competency tests. During the CBT and interview, TSA assesses competencies, such as oral communication, attention to detail, conflict management, critical thinking, flexibility, integrity, honesty, teamwork, and situational awareness. Examples of potential enhancements include personality tests and practice tests given at colleges to determine whether students are a fit for TSO positions.

In April 2018, TSA officials completed research on the potential effectiveness of assessing job compatibility during the hiring process. TSA officials said the job compatibility assessment is a pre-employment suitability screening that focuses on personality-related, motivational, and attitudinal competencies that are critical for job performance. TSA officials said their goal for this initiative was to develop and implement a valid assessment to strengthen the TSO applicant pool by identifying applicants least and most likely to be a good fit for the position. HC will complete this initiative and incorporate the assessment

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WHY CRITICAL THINKING ?

- Critical Thinking and effective Communication (CTEC) in Aviation inspires problem-solving and helps assist with informed decision making while using affective ways to communicate.

CTEC and OPTIMIS provide:

- The Ability to analyze complex situations .

- Provide and Inspire Higher education on CTEC skills for Aviation Industry careers.

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WHY EFFECTIVE COMMUNICATION ?

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Clear → Concise → Unambiguous

SWOT Analysis

The below table provides an analysis of TSA strengths, weaknesses, opportunities, and threats (SWOT). The result of the SWOT analysis was determined through discussions with OSCPA personnel.

Strengths	Weaknesses
Talented workforce	Need for more two-way communication
Important mission	Resistance to change
Viable, high-impact projects	Layers of review
Clear priorities	Coordinating communications, especially with the field
Strong interest—public/media/Congress	Lack of consistency in messages
Excellent work-life support programs	Tendency towards reactive versus proactive methods

SWOT Analysis, of strengths and Weakness of TSA Communication styles.

Freedom of Information Act branch - governmentattic.org. (n.d.-a). https://www.governmentattic.org/21docs/TSA-OSCPAstratCommPlan_2015.pdf

The other C's

- The elements of effective communication can be characterized into seven different principle:
- 1.Clear - easy to perceive, understand, or interpret
- 2.Correct - free from error; in accordance with the fact or truth
- 3.Complete - having all the necessary or appropriate parts
- 4.Concrete - specific ; definite
- 5.Concise - brief but comprehensive
- 6.Coherent - logical and consistent
- 7.Courteous - polite, respectful, and considerate in manner

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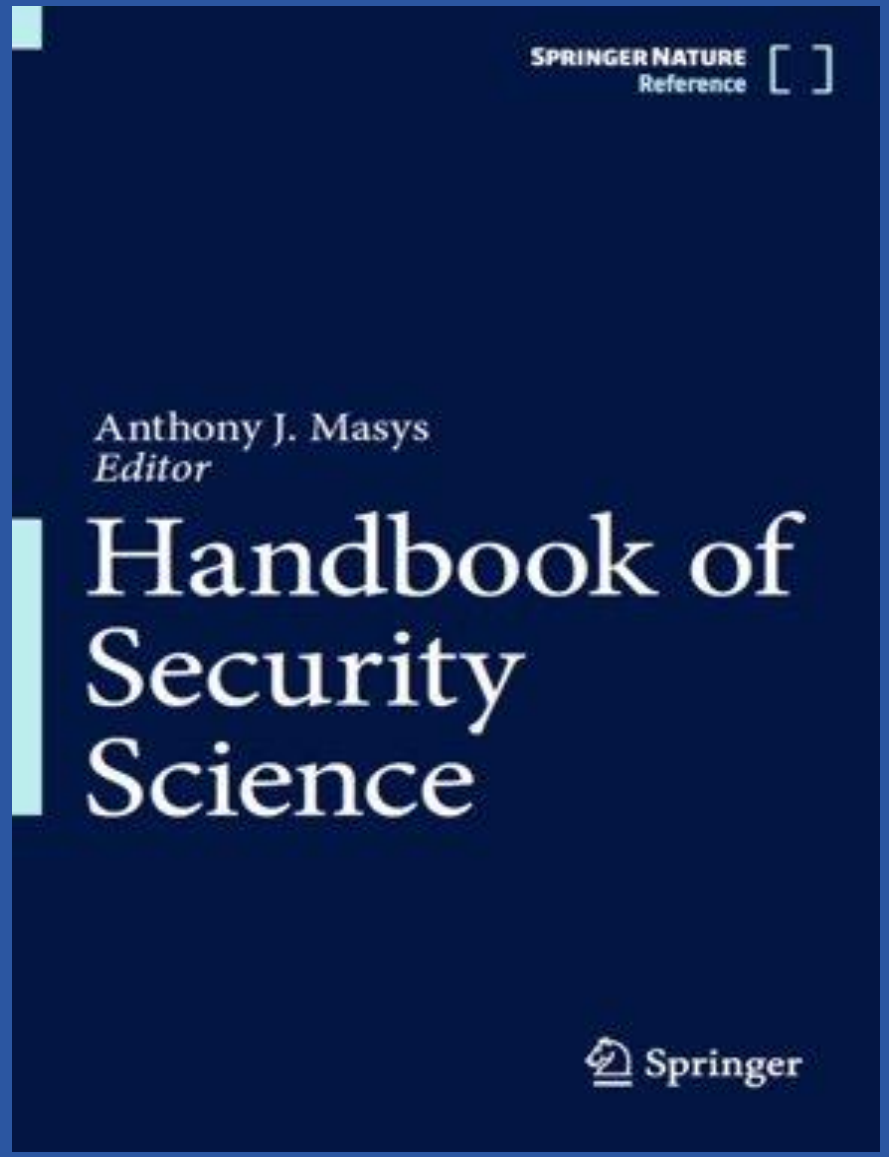
Critical Thinking and Effective Communication (CTEC) PEDAGOGY



Critical Thinking and Effective Communication in Security Domains 2

Cihan Aydiner

Contents

Abstract

This chapter explores the critical thinking and effective communication skills in security domains both for educational and professional settings. The literature shows the gap among research, learning goals, teaching, and practice of critical thinking and effective communication skills in education and training. So, this study aims to create a starting guidance document to improve these skills in security domains with a direct approach. This study conceptualizes these skills as shown in the literature and shows the barriers as well as strategies to prevent barriers for critical thinking and effective communication developments. Also, it provides examples to teach these skills in security domains by asking appropriate questions, using selected red teaming techniques, and discussing recommendations for effective communication. This study asserts that direct approaches to teaching and applying critical thinking and effective communication skills may

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A. J. Masys (ed.), *Handbook of Security Science*,
https://doi.org/10.1007/978-3-319-91875-4_2

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Red Teaming

	Red teaming techniques	Main goal	When to use for CT development in security domains	Resources (the USA, the UK, and Australia)
1.	Devil's advocacy	Challenging the dominant view by proposing the best alternative.	To create contrary arguments for security issues and support decision-making. To avoid focusing on one idea with incomplete/ false assumptions, reasoning, or overconfidence.	US Government (2016), Kardos and Dexter (2017), Landry (2017), Matherly (2013), UFMCS (2018), UK MOD (2021) and Zenko (2015)
2.	Key assumption check	Testing assumptions	To synthesize the implicit and explicit assumptions at the beginning of a security project	
3.	Outside-in-thinking/ outside-in analysis	Disclosing counter-intuitive variables by including an external view	To critique insider security professionals' perspectives. To compose imaginative and critical perspective	
4.	Premortem analysis	Finding key potential issues before the mortem	To evaluate possible susceptibilities of a security/defense plan	
5.	What if analysis	Realizing the risks better by thinking about what happens if expectations do not happen	To evaluate unexpected security risks. To avoid reaching a decision based on limited information and expectation about a security situation.	US Government (2016), Kardos and Dexter (2017), Matherly (2013), UFMCS (2018), UK MOD (2021) and Zenko (2015)
6.	Analysis of competing hypotheses	Examining hypotheses that explain the situation	To examine proposed explanations systematically.	

Red Teaming

7.	High impact/ low probability analysis	Considering on less likely events which if happens may cause a lot	To create an analysis for situations that may less likely realize by encouraging out of box thinking	
8.	Alternative future analysis	Predicting complex and uncertain situations may develop in a plan or situation	To estimate possible outcomes for the future of the security plan/event	US Government (2016), Matherly (2013), UFMCS (2018), UK MOD (2021) and Zenko (2015)
9.	Brainstorming	Providing diverse perspectives about the situation	To examine security issues by taking the contributions of all parties and stakeholders	Kardos and Dexter (2017), Matherly (2013), UFMCS (2018), UK MOD (2021) and Zenko (2015)
10.	Stakeholder mapping	Highlighting the perspectives of stakeholders	To evaluate how stakeholders will have an influence or be affected by the security plan	US Government (2016), Matherly (2013), UFMCS (2018) and UK MOD (2021)
11.	Argument mapping	Assessing the high standards and coherence of logic lies behind the plan	To critique the reasoning used to create a security plan	Kardos and Dexter (2017), Matherly (2013), UFMCS (2018) and UK MOD (2021)
12.	S-W-O-T analysis	Viewing the case by using strengths, weaknesses, opportunities, and threats	To appraise different perspectives for the evaluation of a security situation or plan	Kardos and Dexter (2017), Matherly (2013) and UFMCS (2018)

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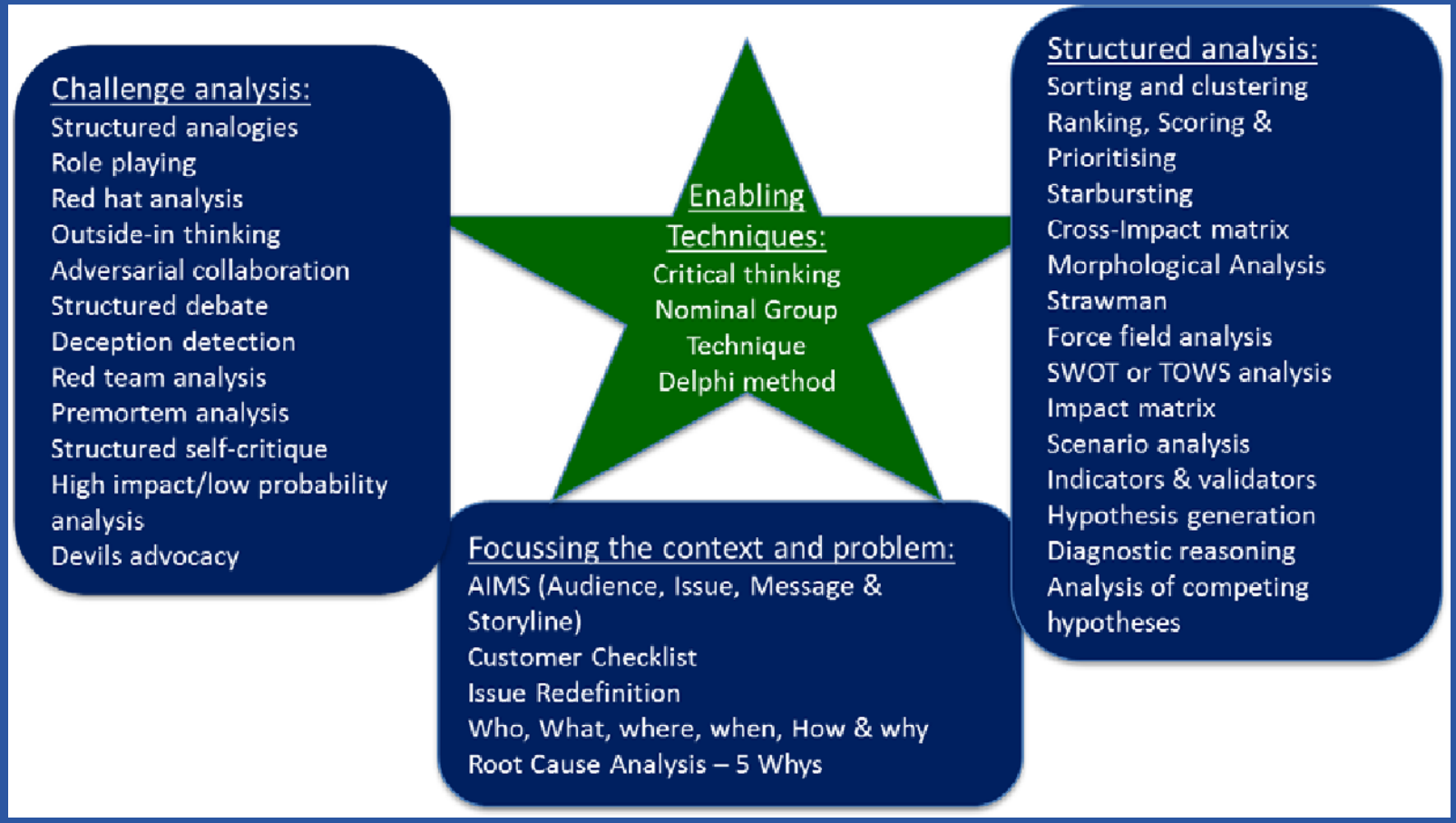
RED TEAMING TECHNIQUE

- Scenario Planning
- Devil's Advocacy
- Pre-mortem Analysis
- Alternative Analysis
- Red Team Support



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Asking Essential Questions

Question checklist for critical thinking
1. What are the issue and the conclusion?
2. What are the reasons?
3. Which words or phrases are ambiguous?
4. What are the value conflicts and assumptions?
5. What are the descriptive assumptions?
6. Are there any fallacies in the reasoning?
7. How good is the evidence?
8. Are there rival causes?
9. Are the statistics deceptive?
10. What significant information is omitted?
11. What reasonable conclusions are possible?

(Browne & Keeley, 2018)

Asking Essential Questions

Intellectual standards	Possible questions
Clarity	Could you elaborate further?
	Could you give me an example?
	Could you illustrate what you mean?
Accuracy	How could we check on that?
	How could we find out if that is true?
	How could we verify or test that?
Precision	Could you be more specific?
	Could you give me more details?
	Could you be more exact?
Relevance	How does that relate to the problem?
	How does that bear on the question?
	How does that help us with the issue?
Depth	What factors make this a difficult problem?
	What are some of the complexities of this question?
	What are some of the difficulties we need to deal with?
Breadth	Do we need to look at this from another perspective?
	Do we need to consider another point of view?
	Do we need to look at this in other ways?
Logic	Does all this make sense together?
	Does your first paragraph fit in with your last?
	Does what you say follow from the evidence?
Significance	Is this the most important problem to consider?
	Is this the central idea to focus on?
	Which of these facts are most important?
Fairness	Do I have any vested interest in this issue?
	Am I sympathetically representing the viewpoints of others?

(Paul & Elder, 2005)

Benefits of teaching CTEC

Valuable and useful preparation for our future Aviation Leaders

Clear and concise thinking

Situational awareness

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What we will have done for the TSA workforce after completing our study?

After completing research, we will have successfully accomplished

- Effective Communication styles for Aviation Professionals: TSA's
- Inspired the conversations in Critical Thinking.
- Help tackle ineffective behaviors and shorten mental fatigue.

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CONCLUSION

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End-user Requirements for Subsequent Research, Discussion & Closing Remarks

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THANK YOU

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