HACKING STRESSED

Fatigue, frustration, and the pursuit of happiness

Celeste Lyn Paul
National Security Agency

Presented at THOTCON 0xA

ABOUT @CELESTELYNPAUL

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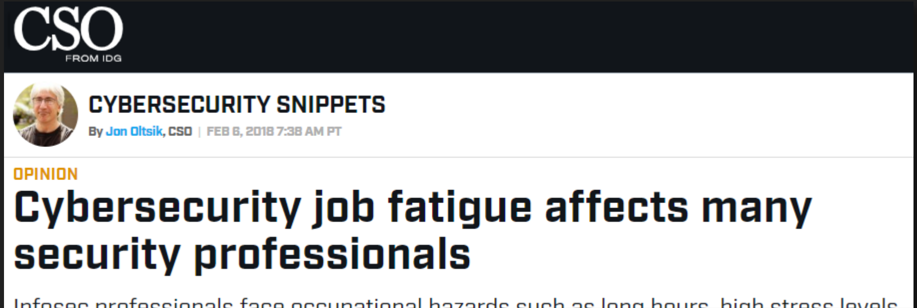
PhD Human-Centered Computing

Hackers are people too



CSO FROM IDG

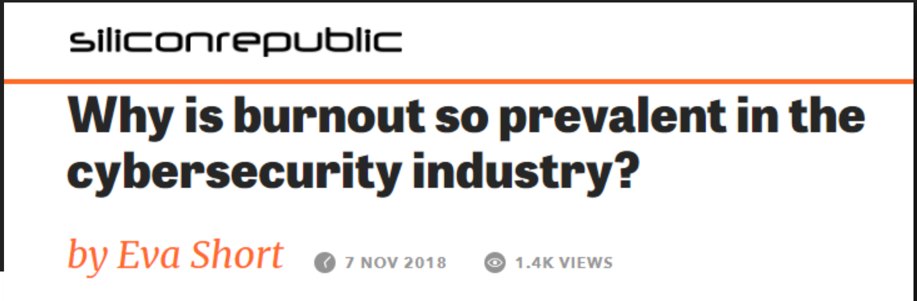
CYBERSECURITY SNIPPETS

By Jon Oltsik, CSO | FEB 6, 2018 7:38 AM PT

OPINION

Cybersecurity job fatigue affects many security professionals

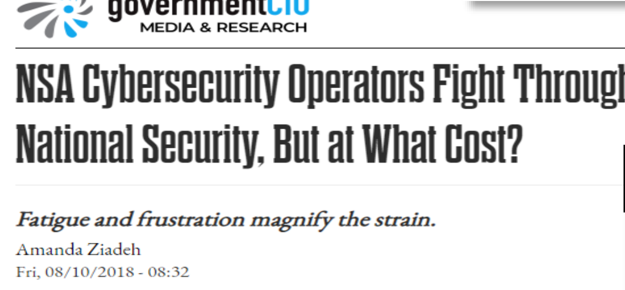
Infosec professionals face occupational hazards such as long hours, high stress levels and career frustration that can lead to mental he



siliconrepublic

Why is burnout so prevalent in the cybersecurity industry?

by Eva Short 7 NOV 2018 1.4K VIEWS

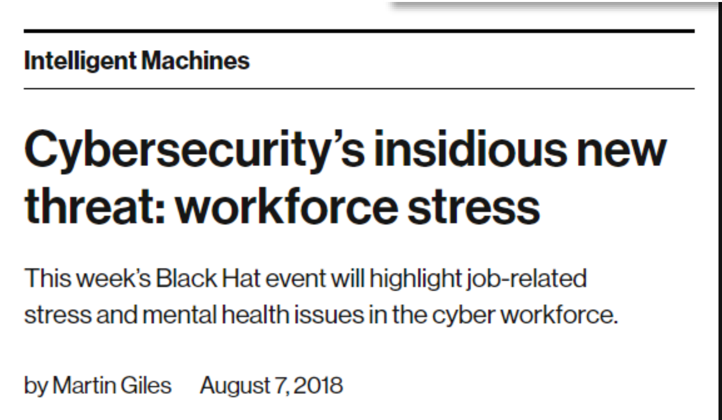


governmentCIO MEDIA & RESEARCH

NSA Cybersecurity Operators Fight Through Stress for National Security, But at What Cost?

Fatigue and frustration magnify the strain.

Amanda Ziadeh
Fri, 08/10/2018 - 08:32



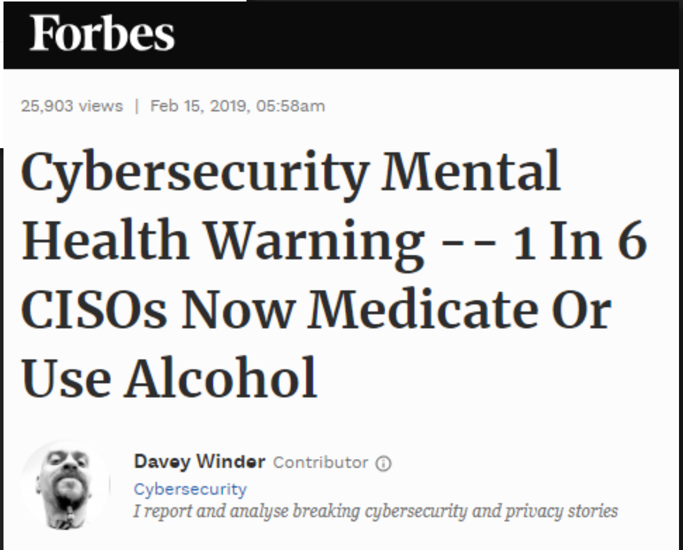
MIT Technology Review

Intelligent Machines

Cybersecurity's insidious new threat: workforce stress

This week's Black Hat event will highlight job-related stress and mental health issues in the cyber workforce.

by Martin Giles August 7, 2018



Forbes

25,903 views | Feb 15, 2019, 05:58am

Cybersecurity Mental Health Warning -- 1 In 6 CISOs Now Medicate Or Use Alcohol

Davey Winder Contributor
Cybersecurity
I report and analyse breaking cybersecurity and privacy stories

Senior

WHAT IS STRESS?

Stress is a **physical** and **emotional** reaction to adverse events.

ACUTE	Temporary ‘fight or flight’ response
EPISODIC	Repetitive stress with little time to recover
CHRONIC	Enduring situations with no sense of control

WHAT IS STRESS?

Stress is a **physical** and **emotional** reaction to adverse events.

BURNOUT

ACUTE Temporary ‘fight or flight’ response

EPISODIC Repetitive stress with little time to recover

CHRONIC Enduring situations with no sense of control

WORK-RELATED STRESS

Demanding job with **little control**.
Effort/reward **imbalance**.

STRESS AND WORK

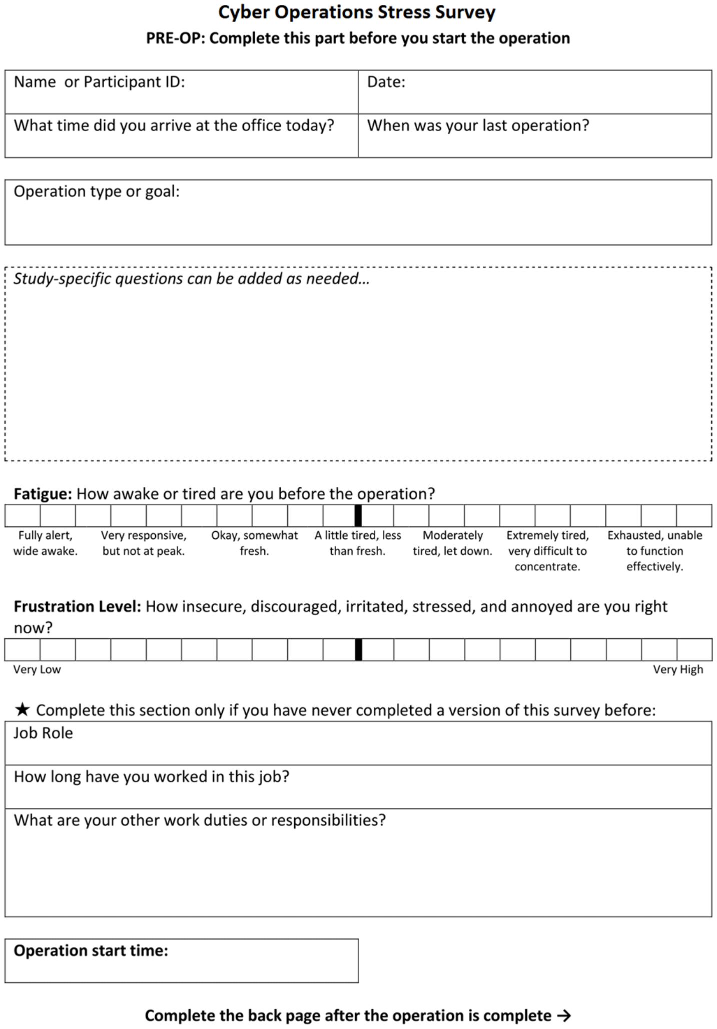
FATIGUE	Physical and mental feelings of **tiredness**
FRUSTRATION	**Anxiety and annoyance** over lack of control
COGNITIVE WORK	**Mental effort** needed to use memory

WHY IS HACKING SO STRESSFUL?

- ☑ Complex problems
- ☑ Unpredictable environment
- ☑ High risk/high reward operations

STRESS & HACKING @NSA

- 4 NSA locations
- 126 tactical operators
- 361 operations
- CIV and MIL operators
- Average op length ~5 hours



Cyber Operations Stress Survey

PRE-OP: Complete this part before you start the operation

Name or Participant ID:	Date:
What time did you arrive at the office today?	When was your last operation?

Operation type or goal:

Study-specific questions can be added as needed…

Fatigue: How awake or tired are you before the operation?

Fully alert, wide awake.	Very responsive, but not at peak.	Okay, somewhat fresh.	A little tired, less than fresh.	Moderately tired, let down.	Extremely tired, very difficult to concentrate.	Exhausted, unable to function effectively.

Frustration Level: How insecure, discouraged, irritated, stressed, and annoyed are you right now?

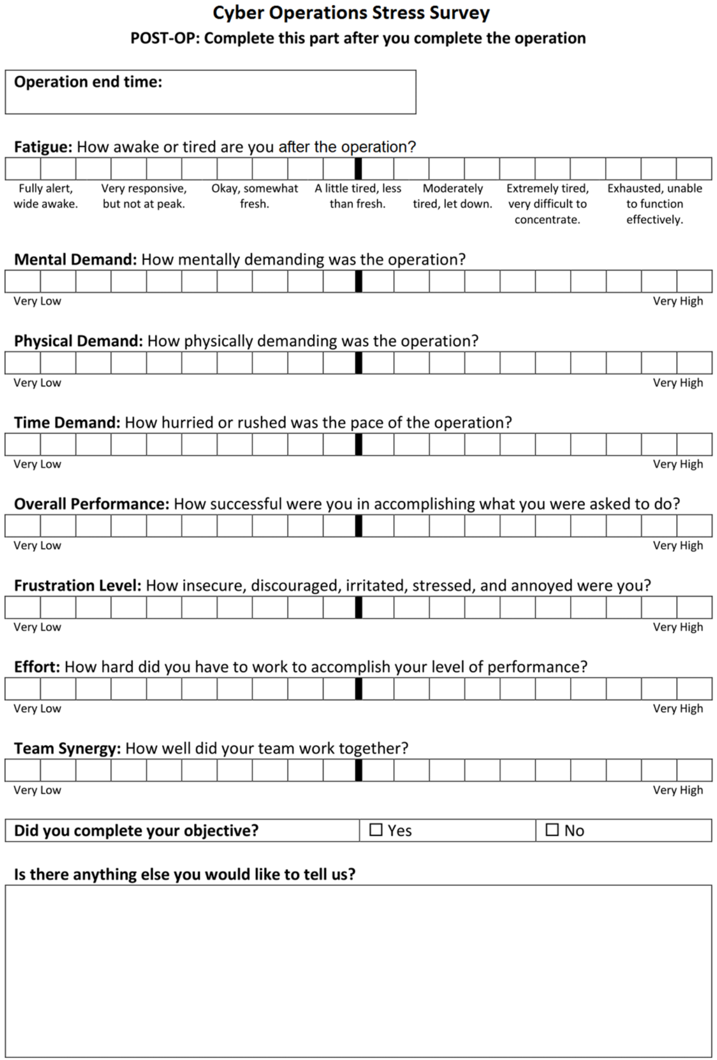
Very Low Very High

★ Complete this section only if you have never completed a version of this survey before:

Job Role
How long have you worked in this job?
What are your other work duties or responsibilities?

Operation start time:

Complete the back page after the operation is complete →



Cyber Operations Stress Survey

POST-OP: Complete this part after you complete the operation

Operation end time:

Fatigue: How awake or tired are you after the operation?

Fully alert, wide awake.	Very responsive, but not at peak.	Okay, somewhat fresh.	A little tired, less than fresh.	Moderately tired, let down.	Extremely tired, very difficult to concentrate.	Exhausted, unable to function effectively.

Mental Demand: How mentally demanding was the operation?

Very Low Very High

Physical Demand: How physically demanding was the operation?

Very Low Very High

Time Demand: How hurried or rushed was the pace of the operation?

Very Low Very High

Overall Performance: How successful were you in accomplishing what you were asked to do?

Very Low Very High

Frustration Level: How insecure, discouraged, irritated, stressed, and annoyed were you?

Very Low Very High

Effort: How hard did you have to work to accomplish your level of performance?

Very Low Very High

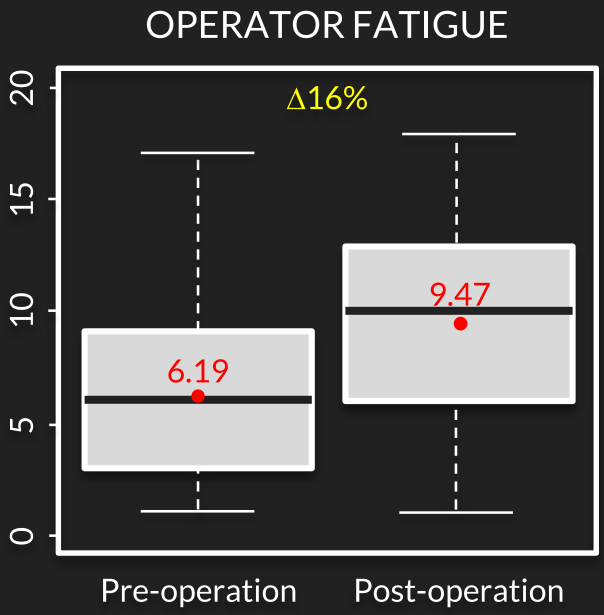
Team Synergy: How well did your team work together?

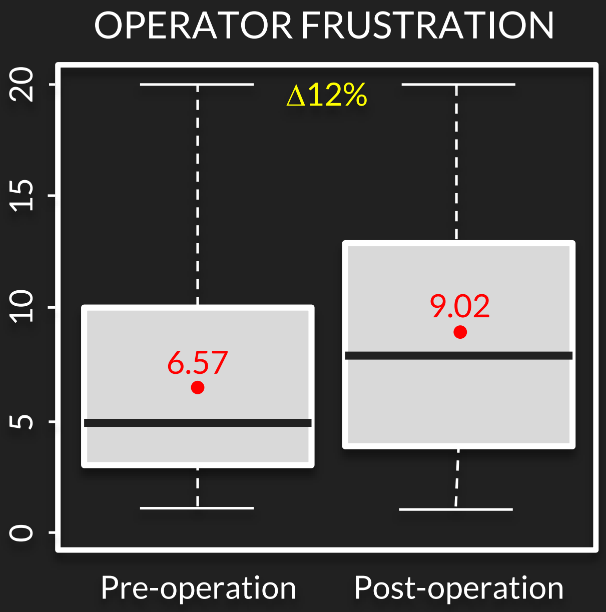
Very Low Very High

Did you complete your objective?	□ Yes	□ No

Is there anything else you would like to tell us?

HACKING IS STRESSFUL

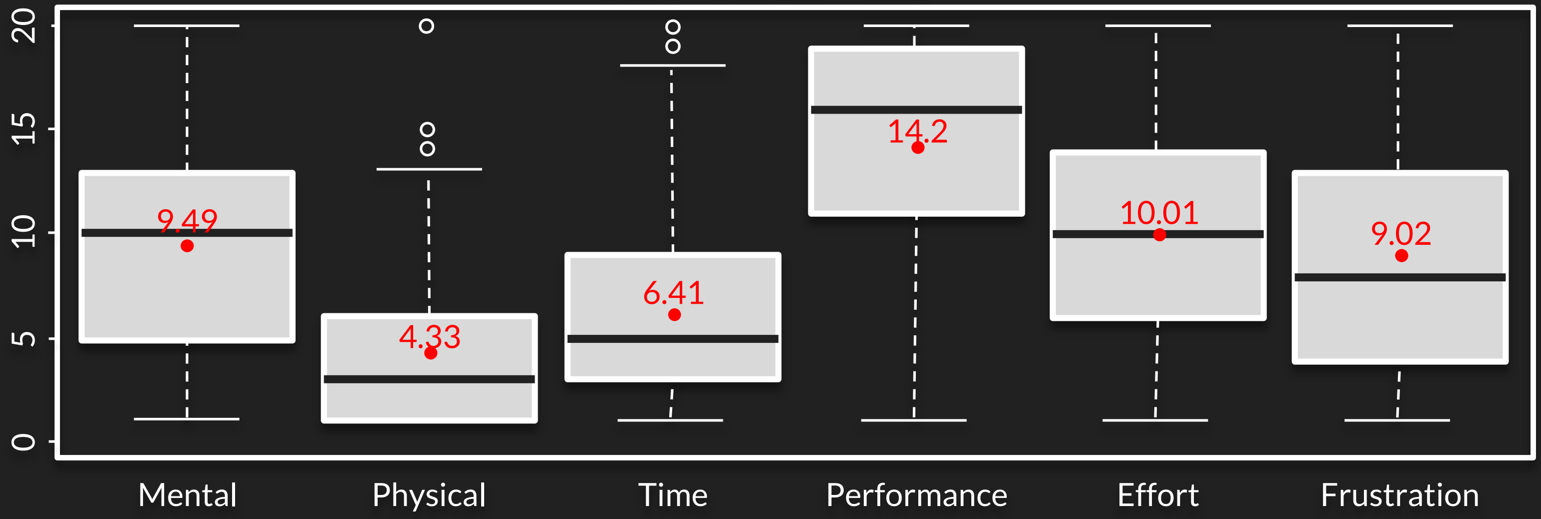




C.L. Paul & J. Dykstra: Understanding Operator Fatigue, Frustration, and Cognitive Workload in Tactical Cybersecurity Operations. *Journal of Information Warfare*, 2017.
https://www.jinfowar.com/journal/volume-16-issue-2/understanding-operator-fatigue-frustration-cognitive-workload-tactical-cybersecurity-operations

HACKING IS STRESSFUL

RTLX = 44.5 (SD = 28.1)



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HACKING IS STRESSFUL

	Mental	Physical	Time	Performance	Effort
Physical	.479*				
Time	.547*	.541*			
Performance	-.034	-.012	-.022		
Effort	.686*	.486*	.509*	-.009	
Frustration	.468*	.334*	.429*	-.315*	.469*

* p < .001

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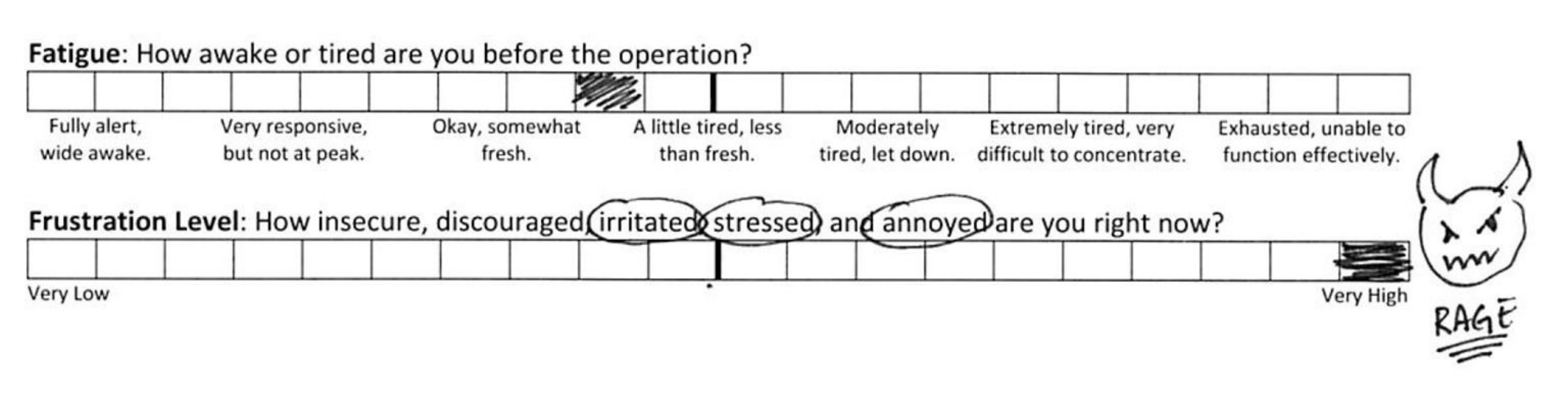
LOCUS OF CONTROL

The extent to which a person feels that they have control over the outcome of events in their lives.



Fatigue: How awake or tired are you before the operation?

□□□□□□□□▨□□□□□□□□□□□

Fully alert, wide awake. | Very responsive, but not at peak. | Okay, somewhat fresh. | A little tired, less than fresh. | Moderately tired, let down. | Extremely tired, very difficult to concentrate. | Exhausted, unable to function effectively.

Frustration Level: How insecure, discouraged, [✓ irritated], [✓ stressed] and [✓ annoyed] are you right now?

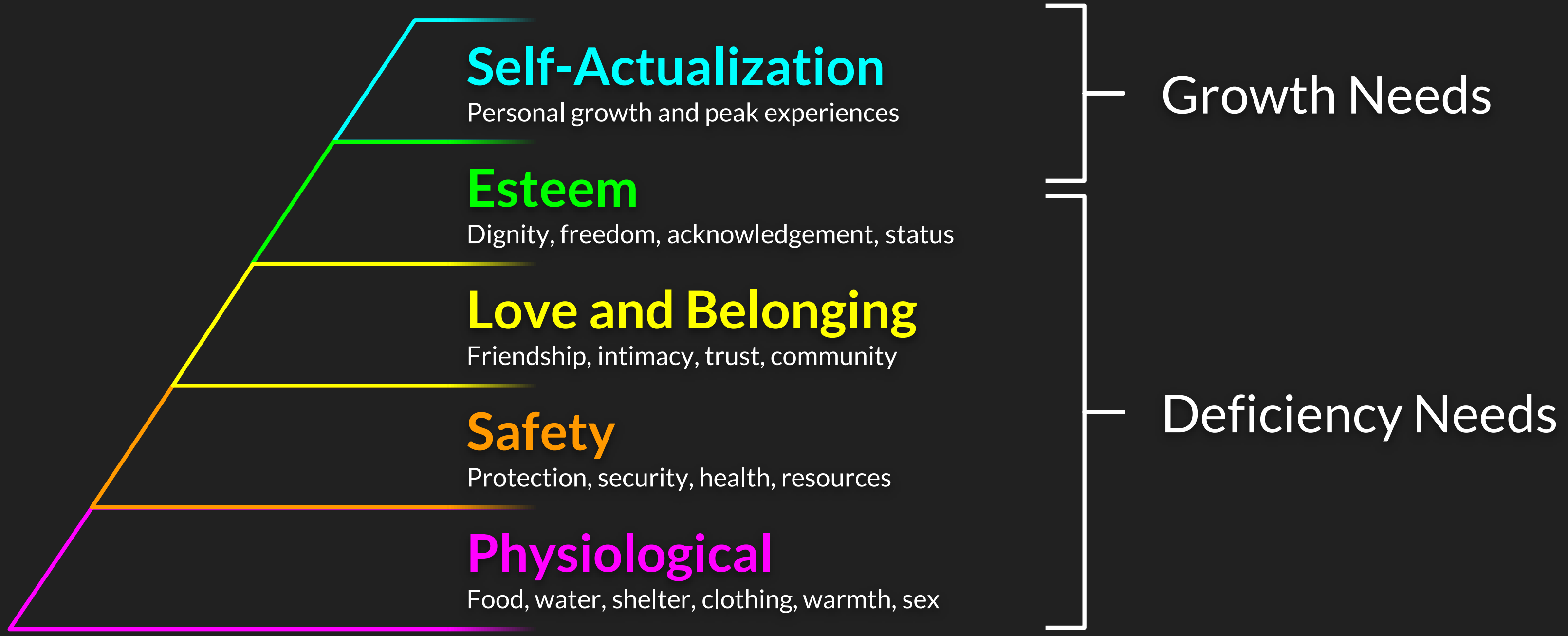
□□□□□□□□□□□□□□□□□□□▨

Very Low | Very High

RAGE

* Don’t worry, [s/he] was fine once the op started

MASLOW’S HIERARCHY OF NEEDS



Self-Actualization
Personal growth and peak experiences

Esteem
Dignity, freedom, acknowledgement, status

Love and Belonging
Friendship, intimacy, trust, community

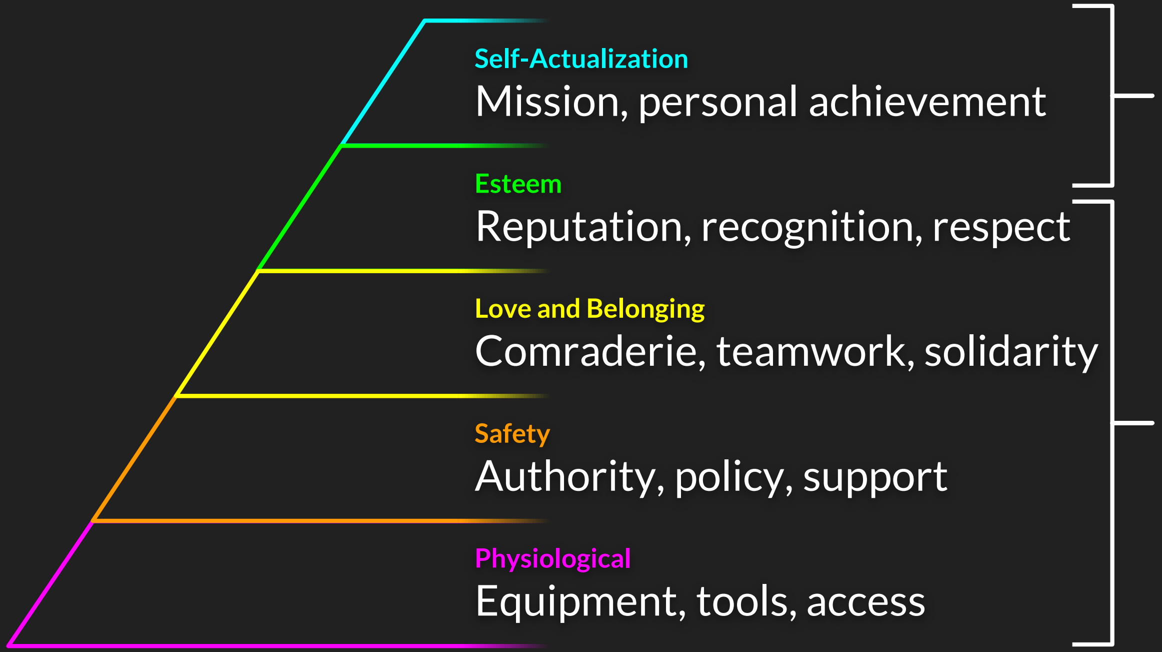
Safety
Protection, security, health, resources

Physiological
Food, water, shelter, clothing, warmth, sex

Growth Needs

Deficiency Needs

HIERARCHY OF *HACKER* NEEDS



Self-Actualization
Mission, personal achievement

Esteem
Reputation, recognition, respect

Love and Belonging
Comraderie, teamwork, solidarity

Safety
Authority, policy, support

Physiological
Equipment, tools, access

What we need to be happy

What we need to do our jobs

Stress can’t be eliminated but, it can be managed.

MITIGATING **STRESS**

PERSONAL

Practice **mindfulness**.

If you’re running hot, **have a spotter**.

Remember that **it will be alright**.

Need to talk to someone? @800273TALK, 1-800-273-TALK
(National Suicide Prevention Lifeline)

ORGANIZATIONAL

Creature comforts matter.

Keep an eye on **time**.

Remember **who** you hired and **why**.

HAPPY HACKING!

Understanding Operator Fatigue, Frustration, and Cognitive Workload in Tactical Cybersecurity Operations

CL Paul and J Dykstra

Research Directorate
National Security Agency, U.S.A.

***Abstract:** While the human factors of mission critical systems such as air traffic control and weapons systems have been extensively studied, there has been little work on cyber operations. As with any system, the perfect storm of complex tasks in a high-risk environment takes an incredible toll on human operators, leading to errors, decreased performance, and burnout. An extensive study of tactical cyber operations at the National Security Agency found that operator fatigue, frustration, and cognitive workload significantly increase over the course of an operation. A discussion of these findings helps us understand the impact that the high-stress, high-risk environment of tactical cyber operations has on its operators.*

Keywords: *Cyber Operations, Cognitive Workload, Fatigue, Frustration, Burnout, Human Factors, Cybersecurity*

Introduction

Cybersecurity operations are a mission-critical service for the safety and business continuity of companies and organizations in the digital world. From red team network penetration testing to real-time defensive monitoring, evolving technology and threats to the network make cybersecurity operations high-value, complex, and difficult. This environment is considerably high-risk, and success or failure can greatly affect the mission or reputation of an organization. Research and development for cybersecurity operations has heavily focused on technological means of achieving a more secure enterprise. However, it is the human experts who play the most critical role in the deployment, configuration, monitoring, and operation of networks.

The National Security Agency (NSA) coordinates, directs, and performs highly specialized activities to protect U.S. government information systems and to produce foreign signals intelligence. One of NSA's missions is to defend the Department of Defense Information Network (DODIN), National Security Systems (NSS), and other critical U.S. government systems. Intelligence analysts and network operators work together around the clock to detect, assess, and prevent foreign threats to networks. In addition to its headquarters in Maryland, NSA has cryptologic centers in Colorado, Georgia, Hawaii, and Texas that also conduct foreign signals intelligence, cyberspace operations, and information assurance operations.

NSA recruits and hires computer network operators to both defend U.S. military networks and to exploit the networks of foreign adversaries. For these jobs, NSA seeks people with

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Cyber Operations Stress Survey (COSS): Studying fatigue, frustration, and cognitive workload in cybersecurity operations

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U.S. Department of Defense

Celeste Lyn Paul
U.S. Department of Defense

Abstract

Operator stress is a common, persistent, and disabling effect of cyber operations and an important risk factor for performance, safety, and employee burnout. We designed the Cyber Operations Stress Survey (COSS) as a low-cost method for studying fatigue, frustration, and cognitive workload in real-time tactical cyber operations. The combination of pre- and post-operational measures with well validated factors from the NASA Task Load Index and additional contextual factors provide a quick, easy, and valuable assessment of cognitive stress. We report on our experiences developing and fielding the survey instrument, validation, and describe the use and results of the COSS in four studies of cyber operations across the National Security Agency.

1 Introduction

Cybersecurity is a high-risk, high-reward profession that can negatively impact a company's technical workforce. While considerable research has helped evaluate and improve technology resiliency, *human* resiliency has been understudied despite the important role of humans in the design and execution of cybersecurity programs [4]. In this paper, we focus on a complimentary goal of measuring human distress which can severely impact operational effectiveness and human health. In particular, we offer a new research instrument for measuring and assessing stress in tactical cyber operations.

Over the past decade, cybersecurity operations have greatly matured. Security monitoring in many organizational environments occurs internally and as a managed service. Security Operations Centers (SOCs) offer one example of this, where dedicated security teams perform threat monitoring, investigation, mitigation, and response to security events. Tasks in the SOC require vigilance of changing threats, increasing volume of alerts, and incomplete monitoring. Other than extraordinary circumstances, such as the discovery of an attack in progress (e.g., distributed denial-of-service) or the discovery of a sensitive data breach, defensive operations typically lack significant time pressure.

Tactical cyber operations. We distinguish a subset of cyber operations called *tactical cyber operations*, in which cyber capabilities are used to achieve specific effects on a network. Capture the flag games for military exercises such as USCYBERCOM's annual Cyber Flag event are an example of this type of work [18]. Another example is red team penetration testing, where an independent group plays the adversarial role and 'attacks' an organization to test that organization's defenses.

Tactical cyber operations are unique in several respects. Performance is highly dependent on speed and precision, just as it is for fighter pilots and surgeons. The longer operation, the greater the risk, such as increased likelihood of unintended detection on the network. Tactical operators require specialized skills and traits. For examples, penetration testers have a breadth of expertise in network and software fundamentals, reconnaissance, exploitation, and adversarial thinking. Training for this type of work is extensive, expensive, and employee turnover is costly. The health of your talent is as much of a risk management issue as it is a human resources issue.

Why we care about stress. A key motivation for this work is the intuition that stress negatively affects operational security, work performance, and employee satisfaction. Tasks that involve attention, memory, and visual perception result in high levels of cognitive demand and fatigue. There is a strong connection between fatigue and stress [21], and fatigue and task performance [12]. We know that stress negatively affects cognitive abilities, task effectiveness, and general well-being. These types of effects are harmful to high-risk, mission-critical environments where failure has great consequence. Stress is detrimental to work that requires creative problem solving —a skill that cyber operators inherently require.

Cyber Operations Stress Survey (COSS): Studying fatigue, frustration, and cognitive workload in cybersecurity operations. *Cyber Security Experimentation and Test*, 2018. https://www.usenix.org/conference/cset18/presentation/dykstra

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