CALL SIGNS

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CONTENT

FROM THE PRESIDENT

Welcome to this edition of *Call Signs*, the scientific newsletter of the US Naval Aerospace Experimental Psychology Society. In this issue, we delve into the latest advancements and insights in the realm of unmanned systems, human systems integration, and artificial intelligence within military applications. We are excited to share five enlightening articles that highlight significant contributions and emerging trends in these fields.

In our first article, **LCDR Joseph Geeseman** explores the findings from NATO's 2023 survey on UAS human factors. This piece sheds light on the critical role of aerospace experimental psychologists and the importance of standardizing human factors requirements across member nations to enhance mission success.

Next, **CDR Brennan Cox** navigates the complexities of Human Systems Integration (HSI), presenting key strategies for advocating end user needs and highlighting the collaborative efforts required to strengthen HSI. This article also delves into the impact of emerging technologies like AI on human roles in technology development.

Our third feature by **Mitchell Tindall and colleagues** discusses the rapid advancements in artificial intelligence and its applications in naval aviation. This article emphasizes the need for a systematic, human-centered approach to ensure the safe and effective integration of AI technologies, maximizing their return on investment.

In a more personal narrative, **LT Kaila Vento** shares her journey from lab coats to flight suits, detailing how a 10-week postdoc program launched her career as a uniformed flight scientist. Her story provides inspiration and insight into the career paths available in this exciting field.

Finally, **LCDR David Rozovski** recounts his experiences from grad school to the Navy, offering a unique perspective on the professional journey within military science and technology.

We hope these articles provide valuable knowledge and inspiration as we continue to explore and advance the intersection of human factors, technology, and defense.

On behalf of the newly elected USNAEPS executive committee, I hope you enjoy this issue of *Call Signs*. Collectively, we look forward to executing the Society's mission and serving your needs as best we can.

- President, CDR Brennan "Tip" Cox
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ADVANCING UAS HUMAN FACTORS

Insights from NATO's 2023 Survey

By: LCDR Joseph "Beans" Geeseman, PhD, AEP #148

As unmanned aircraft systems (UAS) become a core component of modern military operations, NATO has sought to align human factors across member nations to improve mission success. Aerospace experimental psychologists play a critical role in this endeavor, ensuring that UAS systems not only meet technical requirements but are also optimized for human operators.

A recent survey effort led by LCDR Joseph Geeseman (AEP #148) for NATO's Joint Capabilities Group for Unmanned Aircraft Systems (JCGUAS) gathered perspectives from member states on key priorities, risks, and future research needs in UAS development. The findings reveal the importance of standardizing human factors requirements and provide critical insights for professionals interested in the intersection of human-machine interaction.

Collaboration and Priorities in UAS Development

Collaboration among NATO member nations is vital to advancing UAS development. The 2023 survey revealed that member states are focusing on research and development (R&D), information sharing, training, and systems integration as key areas for future collaboration.

Standardizing human factors requirements across nations is particularly important for enhancing operational efficiency. A consistent interface between human operators and UAS systems can reduce training time, improve operator situational awareness, and enhance interoperability across missions. By reducing the learning curve for operators, standardized human-system integration (HSI) also improve mission success, minimizing operational risks associated with poorly designed interfaces.

Highest Priority Items for UAS Development

When evaluating acquisition and development priorities, several areas emerged as crucial for enhancing UAS capabilities. Sense and Avoid systems, which enable UAS to autonomously detect and avoid obstacles, ranked highest among the priorities, followed closely by Human-Autonomy Teaming, which focuses on improving the collaboration between human operators and autonomous systems.

Other significant priorities include Intelligence, Surveillance, and Reconnaissance (ISR) capabilities, the ability to operate multiple UAS simultaneously, and sensor fusion. These areas are seen as critical for advancing the future capabilities of UAS in military operations.

Risks of UAS Use

The survey also identified several key risks associated with the use of UAS in future military operations. These include cybersecurity vulnerabilities, trustworthiness of autonomous systems, and limitations in sense-and-avoid technologies. These risks pose significant challenges to both operational safety and mission success.

Cybersecurity was the most frequently cited risk, reflecting concerns over the vulnerability of UAS to hacking, unauthorized access, and data breaches. Trustworthiness was another critical concern, as operators must be confident in the system's ability to perform as intended and with consistent results in real-time operations. Addressing these risks requires a concerted effort to enhance system transparency and resilience against cyber threats.

Human-Autonomy Teaming and Future Research

One of the most forward-looking as-

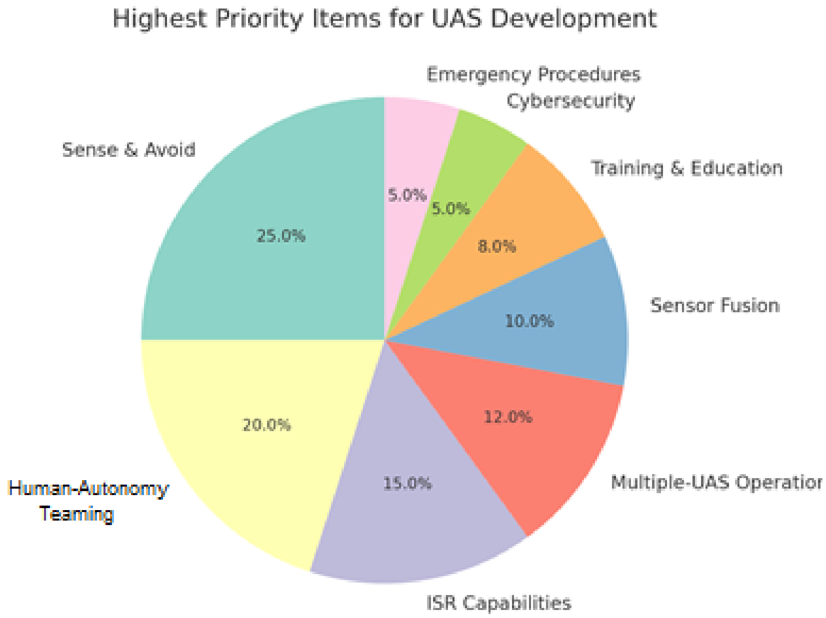

Figure 1. Sense and Avoid and Human-Autonomy Teaming are at the forefront of UAS development efforts, reflecting the need for reliable, autonomous decision-making and collaboration between human operators and machines. These priorities will shape the future direction of UAS technology and its integration into complex operational environments.

pects of the 2023 survey was its focus on Human-Autonomy Teaming (HAT), where human operators work collaboratively with autonomous systems. This concept is seen as vital to future UAS operations, enabling operators to operate UAS in a wide-array of operational contexts covering areas such as manned-unmanned teaming (MUMT) and simultaneous control multiple autonomous platforms (e.g, swarms).

Key research priorities for enabling HAT include enhancing trust in automation, developing explainable AI systems, and refining mission planning algorithms. As autonomous systems become more integrated into military operations, the need for transparent, predictable decision -making becomes increasingly important. Human factors research plays a critical role in designing these systems to be intuitive and reliable for operators under -stress, mission-critical conditions.

Conclusion

The results of NATO's 2023 survey underscore the importance of standardized human factors requirements in optimizing UAS operations. As technology continues to evolve, the need for research in human-autonomy teaming, explainable AI, and system trustworthiness becomes even more critical. Aerospace experimental psychologists are in a unique position to guide the development of these systems, ensuring that they meet the operational needs of military personnel while maintaining safety and reliability.

By continuing to focus on collaboration and advanced research, the AEP community can help shape the future of UAS, making them more effective, safe, and adaptable for the complex challenges of modern warfare.

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NAVIGATING THE HUMAN CHALLENGES OF HUMAN SYSTEMS INTEGRATION

By: CDR Brennan "Tip" Cox, PhD, AEP #142

Navigating the complexities of Human Systems Integration (HSI) presents unique challenges, particularly when balancing human needs with technological advancements. This article presents key strategies for advocating for end user needs, highlights the importance of collaboration to strengthen HSI, and outlines methods for ensuring effective HSI metrics. It also explores how to quantify HSI's impact, presents alternative ways to demonstrate its value, and explores how emerging technologies like Artificial Intelligence (AI) reshape the human role in technology development and application. Each section offers insights and practical approaches to successfully navigate the human challenges inherent in HSI.

Advocating for End User Needs at the Early Stage

In the complex world of defense acquisitions, defining requirements and managing progress often involves balancing competing demands. Advocating for end user needs from the early stages is essential to ensure that the final product meets their expectations and requirements.

One effective strategy is to appoint a dedicated translator who is proficient in both the engineering and operational landscapes. This individual plays a crucial role in ensuring that user requirements are clearly communicated to, and understood by, the engineering team, and vice versa. This approach helps bridge the gap between technical and operational perspectives, facilitating a more cohesive development process.

In addition to having a dedicated translator, employing effective communication tools is vital. Those who have worked in/around the military may be familiar with the "read-back" process; i.e., repeating back what was said to confirm that the instructions were not only received but also understood or interpreted as intended. Such practices help eliminate misunderstandings and ensure alignment among all parties involved.

Continuous engagement with end users is another critical factor. End-user engagement should not be a one-time, check-the-box event. It is not sufficient to merely bring engineers and end-users together to agree on a path forward. Instead, ongoing communication and feedback are necessary throughout the development process. Technology development inherently comes with unanticipated hurdles, making recurrent communication essential for engineers to craft solutions that end users not only can use but also want to use.

By integrating these strategies—employing dedicated translators, using effective communication tools, and maintaining continuous engagement with end users—technology development can better align with user needs and expectations, ultimately leading to more successful and user-friendly outcomes.

Strengthening HSI Through Collaborative Efforts

Collaboration is essential to the effective application of HSI, with different stakeholder communities across government, academia, and industry each serving complementary roles.

Government Initiatives: The government sets HSI requirements and establishes program management standards for HSI processes and products. It also facilitates communication between end users and the engineering communities, ensuring that operator-informed decision-making occurs.

Academic Contributions: Academia advances HSI through dedicated research aimed at developing new tools and methodologies. By publishing data-driven evidence and case studies, academic institutions demonstrate where and how HSI has been effective. Additionally, they provide training and education programs to prepare future HSI practitioners and leaders.

Industry Practices: Industry players adopt HSI guidance and best practices in their system design and development processes. They offer real-world context for evaluating the value of HSI implementation and communicate back to academia and government to address challenges encountered during implementation.

Ensuring Effective HSI Metrics

Reflecting on the adage "what gets measured, gets done," it is imperative that the right HSI metrics are identified and included in system performance evaluation criteria. This process involves several key steps:

Define Goals and Target Audience: Understand the system's objectives and identify the key stakeholders who will benefit from its success. This understanding sets the stage for effective metrics management by addressing their needs, expectations, and potential concerns.

Relevant HSI Domains: Determine which HSI domains are most relevant to the system's specific context and target users. Select metrics that are measurable, reliable, and cost-effective to collect and analyze. Ensure that data gathering techniques are objective and unbiased, using a mix of quantitative and qualitative data to capture a comprehensive picture.

Avoid Shortcuts: Adhere to standards and best practices and assess whether past successful processes are applicable to current conditions. There is no one-size-fits-all set of metrics, so intentional choices are necessary.

Stakeholder Involvement: Engage stakeholders and end users to identify and select metrics that matter, avoiding reliance solely on "best practices."

Publication and Reporting: Document and share chosen measures and the rationale behind them. This is crucial in any scientific endeavor, providing a record that others can refer to, preventing repeated mistakes, and facilitating continuous improvement.

By following these steps, we can ensure that HSI metrics are effectively integrated into system development, ultimately leading to improved outcomes.

Quantifying the Impact of HSI

A common HSI challenge is demonstrating value, particularly because HSI outcomes, such as reducing mishaps, span multiple disciplines. Methods to measure and quantify HSI's impact include:

Cost Savings: This can be achieved through reduced training costs, lower maintenance expenses, and fewer errors. For example, if an HSI-informed design cuts training time by 20%, the corresponding cost savings can be calculated based on the reduced training hours. Such savings (or cost-avoidance) clearly illustrate the economic benefits of integrating HSI into technology development.

Performance Improvement: Another important metric is performance improvement, which includes factors like task completion time, workload reduction, and user satisfaction. Higher user satisfaction typically indicates a system that is more intuitive, easier to use, and less prone to errors—all of which are primary goals of HSI.

Return on Investment: ROI calculations are crucial for determining the overall value of HSI initiatives. By comparing the costs of implementing HSI, including additional design time and training costs, with the benefits, such as reduced errors and increased efficiency, acquisition professionals and technology developers can determine the financial returns of their HSI efforts.

Alternative Ways to Demonstrate HSI Impact

Beyond traditional metrics, there are

several alternative ways to show the impact of HSI:

Case Studies and Testimonials: Real-world examples and firsthand accounts can effectively demonstrate HSI's value.

Awards and Recognition: Achievements acknowledged by professional organizations can validate the significance of HSI efforts.

Publication in Peer-Reviewed Journals: Scholarly articles provide credible evidence of HSI's efficacy and contribute to the broader knowledge base.

Increased User Adoption: High rates of user adoption signal that the system is user-friendly and meets the needs of its intended audience.

It's important to remember that HSI benefits do not always translate directly to cost savings. There are other ways to express value, making it vital to frame results in a way that resonates with stakeholders and decision-makers. Understanding what matters most to them—whether political, social, or operational considerations—helps in communicating the importance of HSI effectively.

The Future of HSI in Systems Acquisition and Development

As technology, particularly AI, continues to evolve, the role of HSI in systems acquisition and development is poised for significant transformation over the next 5 -10 years.

Shifting Focus: As AI takes over repetitive tasks, HSI will increasingly prioritize understanding how AI complements and enhances human capabilities. The design of systems will need to leverage the strengths of both humans and AI, fostering effective collaboration and building trust between the two. This shift will involve creating interfaces and workflows that allow humans to capitalize on AI's capabilities while retaining overall control and oversight.

New Techniques and Tools: The advancement of AI will bring new HSI tools into play. AI-powered HSI tools for data analysis, user modeling, and risk prediction will streamline HSI processes and help identify potential issues earlier in the development cycle. Mixed reality environments will become more prevalent for user testing, providing immersive and realistic settings to evaluate human interaction with complex systems. Additionally, there will be an increased focus on neuroergonomics and biometrics to understand brain activity and physiological responses, offering deeper insights into user experience and cognitive workload, ultimately leading to more intuitive and user-friendly interfaces.

Increased Emphasis on Ethical Considerations: As AI systems become more integrated into various aspects of human life, ethical HSI considerations will emerge. Transparency and explainability in AI decision-making will be crucial for building trust and mitigating bias. Ensuring algorithmic fairness and inclusivity will help to ensure systems are designed according to diverse user populations. Maintaining human oversight and control over AI-powered systems, particularly in critical decision-making scenarios, will be fundamental for ethical and responsible development.

Evolving Human Roles: The roles of HSI professionals will also evolve as AI technology advances. HSI practitioners may need to become AI specialists, understanding the capabilities and limitations of AI to integrate it effectively and responsibly into systems. As AI automates routine tasks, human roles will increasingly focus on higher-order cognitive skills such as creativity, critical thinking, problem-solving, decision-making, and collaboration. Lifelong learning and adaptability will be essential for HSI professionals to keep pace with the rapid technological changes and remain relevant in their field.

Conclusion

Navigating the human challenges of HSI demands a multifaceted approach. Advocating for end user needs, fostering collaborative efforts, and establishing effective HSI metrics are pivotal steps. Quantifying HSI impact and value remains a priority. As technologies evolve, so too will HSI, based on adaptation of human roles. Integrating human-centered design principles into complex systems, consistent with the strategies herein, ultimately enhances total system performance, safety, and user satisfaction.

A HUMAN-CENTERED APPROACH TO ARTIFICIAL INTELLIGENCE APPLICATIONS IN NAVAL AVIATION

By: Mitchell J. Tindall, Ph.D., Beth F. Wheeler Atkinson, Jordan M. Sanders, Sarah C. "Little Debbie" Beadle (AEP #164), and James A. Pharmer

The rapid pace of technology improvements and developments is a concept that affects individuals in every sector of life, from personal devices to enhancing job performance. However, emerging technological advances in component technologies such as artificial intelligence continues to increase the rate at which innovative solutions are available. In fact, Sevilla and colleagues (2022) found that over the last decade the performance of artificial intelligence (AI) systems has doubled every six months, greatly outperforming Moore's Law. Considering this pace of advancement, application of these capabilities in high stakes settings like military domains should not be done arbitrarily nor haphazardly. Further, part of a user centered identification of reasonable applications and requirements for AI technology should consider not only the technological capabilities but also the human needs and abilities to effectively rely on AI implementations. While literature on human-autonomy teaming has documented effective approaches to the application of AI and automation (O'Neill, McNeese, Barron, & Schelble, 2020; Huang, Cooke, Johnson, Lematta, Bhatti, Barnes, & Holder, 2020) the approach outlined in this paper focuses on mission specific tasks and adapting/integrating with the warfighter in their context, vice approaches to design AI well before it reaches the end user.

In military domains, a standardized process during early phases of acquisition programs exists for defining system requirements and appropriate technological solutions. However, this process does not specifically take into account fast evolving capabilities like AI to assist the human operator. In an environment that encourages speed to the fleet transitions and fail faster technology investigations, AI offers promising opportunities. As such, the Chief of Naval Operations' 2022 Navigation Plan implores the Naval Forces to: "Leverage [artificial intelligence] to support … warfighting… by 2023, launch a framework to identify gaps and accelerate delivery of AI-enabled capabilities to the Fleet and Navy enterprises."

To support these calls for AI technology adoption, with emphasis on maximizing investments, what is necessary is a systematic, human-centered approach to ensure the application of this technology is done safely, effectively, and in a way that ensures optimal return on investment (ROI). As a rapidly evolving technology, the optimal applications for AI within high stakes, complex systems like naval aviation offer unique use cases that may translate to commercial applications in the future. This paper outlines a proposed process for understanding and defining potential insertion points for automation and AI technologies that sets operational definitions for organization, standardizes an objective method that leverages existing documentation and subject matter expertise, and maintains a human-centered approach to requirements and design.

DEFINING CONCEPTS

For the purposes of this effort, primary concepts for consideration were AI and Automation. Generally speaking, Automation refers to technology used to perform tasks or processes without direct involvement from humans, functioning independently to reduce the need for constant human intervention. Alternatively, AI refers to technological solutions that can perform tasks that typically require human intelligence (e.g., learning, decision-making, problem-solving) by leveraging algorithms and models that enable functions that are analogous to human cognition. However, due to the rapid evolution of this technology in recent years and the variety of solutions within this Automation-to-AI spectrum,

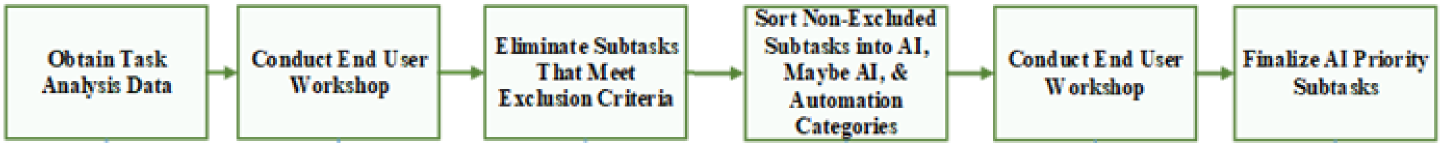

Figure 1: Human-Centered Artificial Intelligence Data Analysis Process

there are a plethora of ways to define these concepts.

Collins, et al. (2021) found 28 definitions for AI in their systematic literature review. As an example, one of these definitions was AI, "…is defined as the ability of a machine to perform cognitive functions that we associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem solving, decision-making, and even demonstrating creativity." Additionally, AI models have been known to cost thousands and even millions of dollars (PaLM, a "…large language model launched in 2022….") (Maslej, N. et al., 2023). Automation, on the other hand, was defined in GeeksforGeeks as "…something which runs itself with little to no human interaction by some specific patterns and rules to perform repetitive tasks." They also determined that there are 7 key differences between AI and automation, including that "AI involves learning and evolving," while automation does not (GeeksforGeeks, 2022). Understanding the state of the art and practice of AI and automation is an important first step in the development of a systematic approach to making AI/automation decisions. This step should result in verbiage that aligns with AI/automation's current functionality (e.g., analysis, verification, synthesis, aggregation).

SCOPING THE ANALYSIS

Within domains such as military training, an important early step in the process is providing a valid and scoped use case. Due to the inherent complexity and variety of systems and capabilities within the military, this process helps manage expectations, minimize scope creep, and eases identification of relevant documentation and subject matter experts (SMEs). To start, the pre-requisite questions utilized were:

- What mission do I want the AI to support?
- Who in that mission do I want to focus on?
- What information security classification do I want to maintain?
- What platforms support the mission I am focusing on?
- Am I able to obtain Front End Analysis tasking data on this mission in these platforms?
- What phase of the acquisition lifecycle is the system in and is there potential funding to implement a change in the future?

DATA ANALYSIS PROCESS

The proposed data analysis process is an iterative multi-step process intended to leverage traditional training system analysis documentation and SME input to provide a comprehensive evaluation of technology opportunities. Figure 1 provides an overview of the primary steps identified during a feasibility analysis conducted within a naval aviation domain.

Step 1. Obtain Task Analysis Data

With the scope outlined by the pre-requisite questions, the next step is to contact relevant stakeholders to gain access to relevant documentation. Types of documentation might include task analysis data, interface design documentation, software user manuals, training material, operational manuals, tactical procedure documentation and the like. Critical aspects of those documents include a list of tasks & sub tasks, specific steps for performing tasks, the knowledge, skills and abilities required to perform tasks, the criticality, difficulty and frequency of task performance, information regarding how a graphic user interface (GUI) is used to perform tasks and the context of task performance. Together this information provides an excellent starting point for further scoping AI development initiatives for communities, platforms and capabilities.

Specifically, these pieces of information are necessary for building criteria for the appropriateness of AI/automation for performing tasks. For example, tasks that contain verbs such as analysis, verification, synthesis, etc...., may be well-suited for AI/automation given the current state of the technology. This narrowing of the task list is crucial before the next steps when SMEs are engaged. To operate platforms and perform missions in military contexts, operators can perform hundreds of tasks and thousands of steps. Engaging SMEs with task, mission and domain information with thousands of data points would be inefficient and unproductive. Therefore, a scoped list of tasks that qualify as good candidates for AI or automation should facilitate highly productive SME engagements.

Step 2. Conduct End User Workshops

While task analysis is a useful starting point for narrowing the scope of an AI/automation development effort, engagement with experienced end-users is imperative for ensuring a detailed and comprehensive understanding of tasks and the job. Additionally, these engagements may yield valuable insight into where to best insert AI into a job that cannot be derived from task analysis data.

- Setup meetings with end users
- Elaborate on task analysis data
- Establish initial end user ideas about AI

End user workshops are particularly beneficial for learning additional mission context that may impact an AI application or expand the scope of a mission. For example, there may be a known gap in sensor performance or an external variable like weather that adds complexity to a given task. Often, these components are not included in Task Analysis data, but would have implications for an AI-based solution. Additionally, by talking to groups of end users, you are able to examine where training is used to supplement complex tasking. Other insights derived from end users that cannot be gleaned from Task Analysis are identifying certain tasks where there is variability in human performance, particularly between novice and expert users, that can highlight a lengthy time-to-train or need for a decision aid.

End user workshops also serve an important role in developing the appropriate language and mission understanding for the human factors team. Identifying the sequence of events and discussing the goals of the mission are critical prior to examining the task data or observing users performing the mission. The secondary benefit of engaging end users early in the process is buy-in and shared interest in the effort as they return to supporting the task. By prompting these stakeholders early in the process with task-related questions and engaging them throughout the lifecycle they share investment in the task. This partnership is critical for their role as gatekeepers into a community of experts and yields ongoing conversation on appropriate tasks for consideration.

Step 3. Eliminate Subtasks via Exclusion Criteria

As previously stated, there is an abundance of potential tasks to examine in any military mission context. At this stage, heuristics are developed to further reduce the amount of potential subtasks to consider. The focus of task reduction is to examine where an AI solution would not be appropriate- both in terms of mission difficulty/criticality and ROI for a technological solution. Within this review, exclusion criteria to consider include:

- Does not apply to desired mission
- All steps are critical
- All steps are not difficult
- Less frequent than once every 6 weeks
- Pertain to non-priority positions / roles
- Require critical thinking skills

The first step to scope is removing tasks that do not support the mission of your focus. Due to the high risk nature of military contexts, any task with subtasks that are deemed 'critical' are not considered- this again impacts our security classification and the overall risk of an AI solution. Tasks that are rarely performed, not difficult, or non-priority are removed from consideration as there is little impact to mission performance with an AI system being added. Last, understanding what knowledge, skills and abilities are necessary for performing tasks can help determine if and what type of AI could be leveraged to perform that tasking. However, KSA information is not always available or descriptive enough for making these determinations. When KSA data lack sufficient detail, often an analysis of subtasks by psychologists illuminate whether things like critical thinking and decision making are necessary for subtasks like analyze, determine, verify, detect, identify, monitor, etc.

For example, the review of a checklist required prior to flight is critical to safety of flight assessments to determine if an aircraft can meet go/no go criteria. While potentially a fit for an assistive automation process, taking the human out of the loop in this situation may have dire consequences.

Other criteria for the elimination of tasks can include:

- Communication
- Requires a human
- Performing a check
- Performing a set of procedures
- Minimal decision-making
- Starting / setting up a system
- Outside designated classification
- Utilizing an existing application with no obvious AI application
- Subtask goal does not align with role / position

These considerations assist with ensuring an AI solution has impact to support the operator versus take over their role on the mission.

Step 4. Sort Non-Excluded Subtasks into Categories

This step focuses on organizing remaining subtasks within one of three categories: AI, Maybe AI, or Automation. Subtasks that require decision-making with several steps sort within the AI category. Alternatively, simplistic decision-making subtasks move within the Automation category. The remaining subtasks, organized as Maybe AI, are likely subtasks that are somewhat ambiguous in wording or due to limited domain context are not easily organized in one of the former categories. For example, subtasks that involve decision-making but lack details to determine the complexity of associated steps may require additional engagement with end users to determine if they better align with AI or Automation.

Step 5. Conduct End User Workshops

End user workshops at this phase in the process are targeted on verifying the scoping from the previous step, refining an understanding of ambiguously described tasks and subtasks for further scoping, and offering additional insight into potential recommendations for technology solutions not afforded from task analysis data. As such this step includes:

- Fill in blanks of task analysis data.
- Attain classification verification (i.e., AI or Automation) on subtasks.
- Validate a final list of subtasks.

Step 6. Finalize AI Priority Subtasks

During this final step prior to prototype investment and development a final narrowed done list of tasks, sub tasks and steps should be complete. A workshop that should include all relevant stakeholders (e.g., scientists, computer scientists, fleet end users, software engineers, program managers, leadership) will rate the tasks based on several criteria. That criteria includes prioritization, AI/automation type and vulnerability/exploitability. Depending on the size of the final list, ranking ordering or simple high, medium or low priority rating could be used to determine where initial prototype investment should focus.

There are roughly seven types of AI (e.g., theory of mind, natural language processing, neural networks) (Joshi, 2019). To start envisioning the architecture of a prototype, the workshop group should determine what type of AI/ automation is best suited to performing tasks. This step helps determine cost of development, an important consideration for maximizing ROI and potentially revisiting prioritization rankings/ratings. Unique to military contexts is the fact that there are forces motivated to neutralize any capability advantage you maintain. While recent advances in AI have proliferated at an exponential rate, there are still notable limitations to each type of AI. Those limitations could result in vulnerabilities that adversaries will try to exploit. As such, the workshop group should consider several facets of vulnerability and exploitability of the AI type selected from the previous step. These facets should include whether the AI and a human are equally easily exploited, whether the AI but not a human would be easily exploited, whether the AI has limited chance of being exploited and whether the AI has no chance of being exploited. The vulnerability/exploitability criteria not only offers an opportunity to further refine your priorities list, it ensures investments are not made in a system that could result in a significant vulnerability that inhibits mission performance or at worst puts lives at risk.

PROCESS IN PRACTICE

This process was implemented for two aviation platforms, scoped to a single mission set. The results provide a preliminary look at how this process might assist decision makers with scoping initial discussion for emerging AI technology to maximize resources.

Within the first aviation platform, an existing front end analysis provided a total of 1,783 relevant subtasks or tasks that contained no subtasks. In Step 3 of the outlined process, 1,670 subtasks were excluded and categorized in a None category for relevance to AI or Automation. During Step 4 of the process, the remaining subtasks were organized in the remaining three categories. Figure 2 provides a summary of the results with additional data on the justification for categorization.

While there were fewer available subtasks within the second aviation platform documentation, a total of 234 relevant subtasks or tasks that contained no subtasks were identified. Exclusion criteria (Step 3) resulted in 157 subtasks being categorized as None. However, due to the robust subtask data to include criticality and prioritization information available for this data set, Step 4 analyses included not only categorization of subtasks as AI or Automation, but also the types of technology that might be beneficial. Figure 3 provides a summary of the results with additional data on the justification for categorization.

CONCLUSION

Defining the current state of the technology, leveraging systematically collected task analysis data, and frequently engaging experienced end users will increase the likelihood of the safe and effective application of AI/ automation development efforts. In addition, such a systematic approach to making these decisions enhances decisions regarding development and implementation with data to support tradeoffs and prioritization. For these reasons, there is an increased likelihood that solutions will maximize organizations' return on investment and benefits associated with AI or Automation technologies.

While this process has been used to guide preliminary findings within two aviation platforms for a specific mission set, the resulting human centered systems for making AI determinations is expected to be generalizable across domains or use cases. As more communities

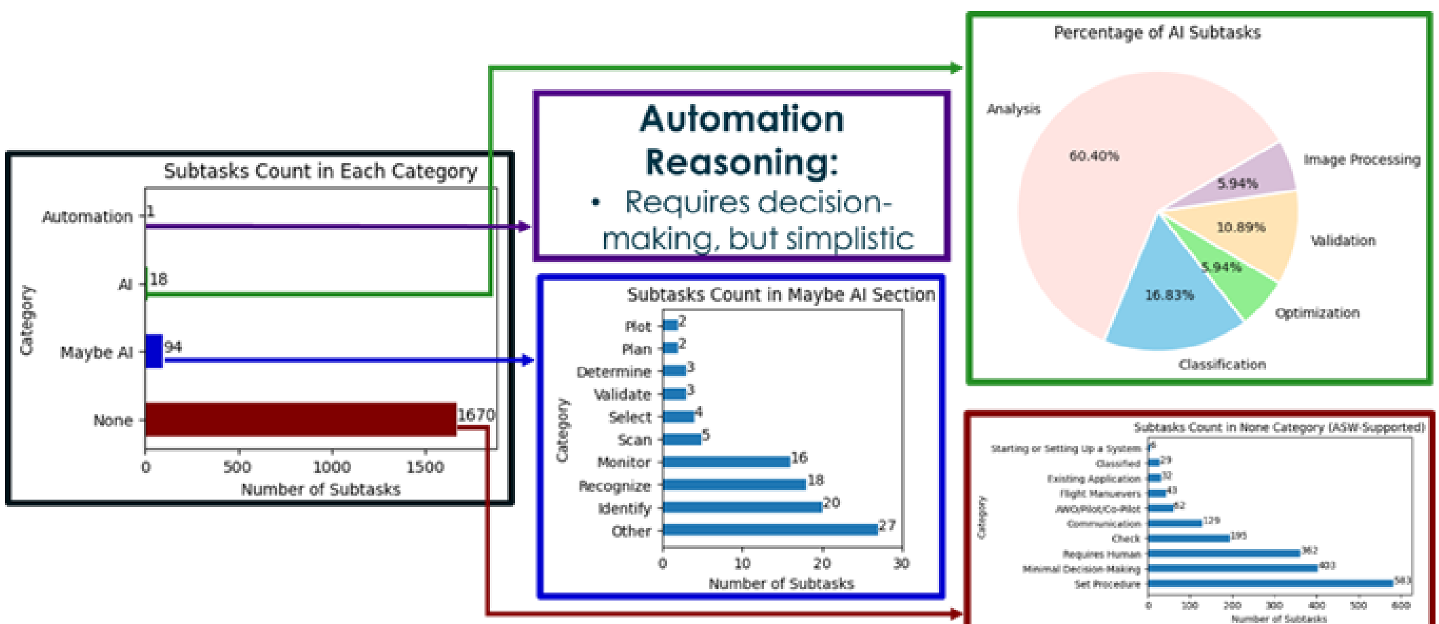

Figure 2: Example Analysis of AI and Automation from Step 4 of Proposed process

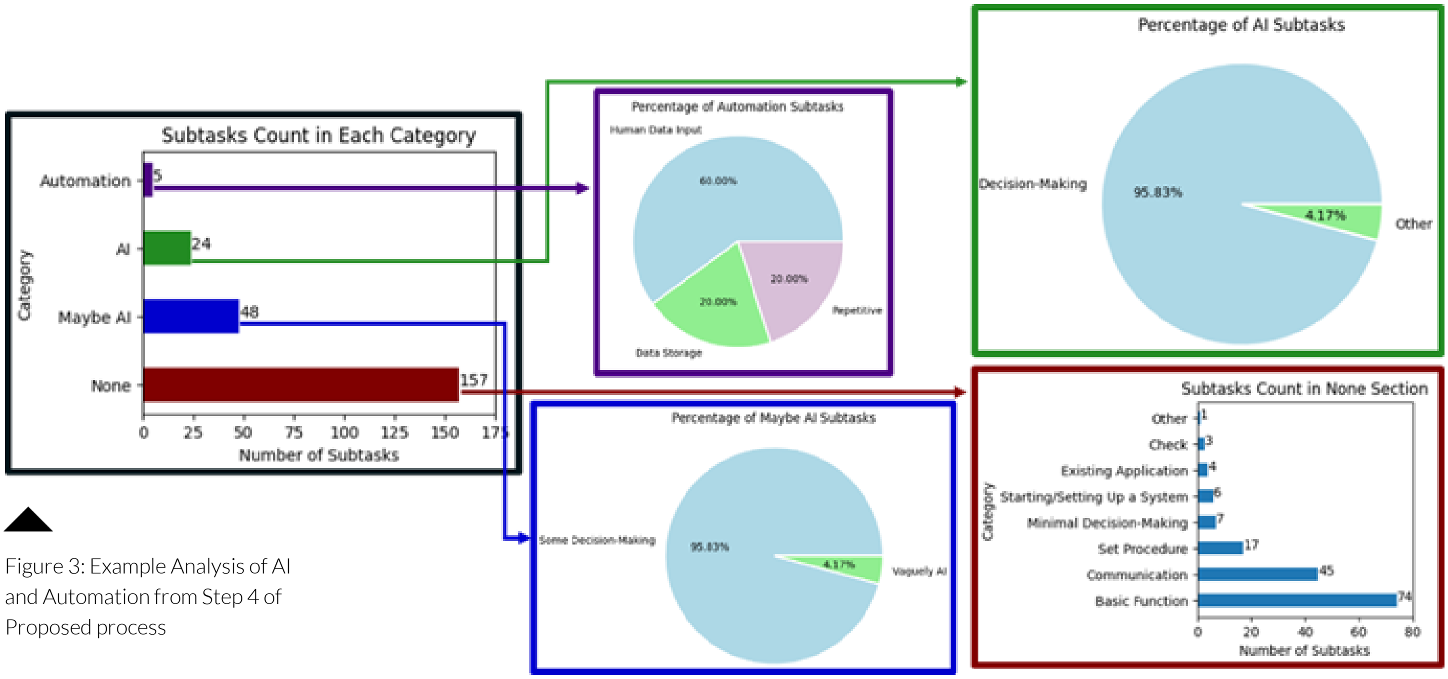

Figure 3: Example Analysis of AI and Automation from Step 4 of Proposed process

and platforms within naval aviation or other domains attempt to adopt AI, we propose that this system would provide a standardized guide for maximizing AI implementation.

It is important to note that targeted AI implementation within a use case will likely maximize benefits to the user community and organizations; however, there are other barriers to adoption of technology that must be considered. For example, recent research with radiologists highlighted that while AI technology for human operator assistance offers useful benefits, "biases in humans' use of AI assistance eliminate these potential gains" (Agarwal, Moehring, Rajpurkar, & Salz, 2023). That is, results of this study suggest that policies that encourage human users to "work next to as opposed to with AI" provided optimal results (Agarwal et al., 2023).

As this effort continues, consistent emphasis on iterative end user engagement will be sought. These working groups to seek end user feedback will afford additional contextualized perspective on the design and implementation of AI solutions. Further, as needs are refined and prioritized, end user engagement is intended to increase buy-in to facilitate effective transition. Aspects of these future workshops will focus on known challenges associated with transparency, trust calibration, situation awareness, workload balancing, vulnerability & exploitability, as well as considerations for policy for implementation to maximize benefits when AI technology is fielded.

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FROM LAB COATS TO FLIGHT SUITS

How a 10-Week Postdoc Launched My Career as a Uniformed Flight Scientist

By: LT Kaila A. "Wizzle" Vento, PhD, MSC, USN, AEP #169

When I earned my Ph.D., my plan was straightforward: commission into the Navy and immediately begin my training to earn my wings as an Aerospace Experimental Psychologist (AEP). However, unexpected delays in commissioning left me with an unforeseen window of time. Rather than letting this gap slow my momentum, I pivoted and secured a 10-week postdoctoral fellowship at Naval Medical Research Unit–Dayton (NAMRU-D), the very unit where I hoped to conduct my first tour. What began as an interim opportunity turned into a critical launching point for my career, preparing me to thrive as a uniformed scientist and shaping my understanding of military aerospace research in ways I hadn't anticipated.

Unlike a traditional academic postdoc, my position at NAMRU-D immersed me in a mission-focused research environment. Here, I wasn't just another scientist working on abstract theories. I was engaged in real-world research with direct operational impacts for Naval aviation, collaborating with experts from across the aerospace and medical communities—AEPs, Research Physiologists, Aerospace Optometrists, and Aerospace Flight Surgeons. This multidisciplinary setting introduced me to the practical realities of research in the Navy, where scientific inquiries are tied to tangible outcomes that support mission readiness.

One of the most valuable takeaways from this experience was learning how to align scientific rigor with the operational demands of Naval aviation. In this environment, research isn't just about advancing knowledge; it's about solving problems that have immediate, real-world consequences. Whether the research supported aviation safety, human performance, or medical interventions, every project had a direct link to the operational needs of the fleet and the aircrew. Understanding how to approach scientific questions through this lens was a critical shift for me, and it's something I continue to apply in my current role at NAMRU-D (I came back for my first tour)!

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Another significant aspect of this fellowship was the exposure it provided to the Navy's unique research infrastructure. I quickly learned the ropes of navigating military funding mechanisms, including how to write and structure grant proposals that would secure the necessary support for projects directly benefiting aerospace operations. Unlike traditional academic grant processes, the Navy's system is deeply integrated with its mission-driven priorities, requiring a level of strategic thinking that goes beyond the scope of most academic research. Yes, I somehow assisted in securing the grant, conducted the study, and wrote the manuscript during my 10 weeks!

A pivotal aspect of my postdoc was the opportunity to participate in ongoing research studies at the unit. I was directly involved in projects focused on critical areas such as hypoxia, spatial disorientation, and hydration—studies that explored the physiological and cognitive effects of these conditions on pilots and aircrew. These research topics were not only fascinating but also personally relevant to my future role. The insights I gained from participating in these studies provided a firsthand understanding of issues that directly impact me now as I fly in both fixed- and rotary-wing aircraft. Experiencing the effects of hypoxia and spatial disorientation through research allowed me to better appreciate the importance of countermeasures and training in mitigating these risks during flight operations. Similarly, the hydration work underscored the role of physiological readiness in high-stress environments, a topic that remains vital in my current research and duties—hence the callsign, Wizzle.

My time at NAMRU-D also helped me sharpen my presentation skills, particularly as a uniformed scientist. In the military, presenting research isn't simply about sharing findings; it's about communicating complex ideas effectively to both scientific and non-scientific audiences, including senior military leaders. This involves translating scientific rigor into actionable insights that resonate with those responsible for making operational decisions. Learning how to adapt my communication style to different audiences was invaluable, and this skill has continued to serve me as an AEP, where I regularly present research that impacts military strategy and decision-making.

The interdisciplinary nature of the unit also broadened my perspective on how research is conducted in the military. Working alongside both uniformed and civilian scientists exposed me to a diverse range of approaches and expertise, helping me appreciate the collaborative culture that drives military research. This environment fostered a strong sense of teamwork, where each researcher's contributions were tied to a collective goal—enhancing the operational capabilities and safety of the pilots and aircrew. This collaborative mindset is something that I've carried with me throughout my career, understanding that success in military research often depends on cross-disciplinary cooperation.

Reflecting on my 10-week postdoc, it's clear that this experience gave me a significant head start in my Navy career. By the time I was commissioned, I had already gained hands-on experience in military research, developed the strategic mindset necessary to align my work with Naval Aviation's operational goals, and refined my ability to communicate complex scientific ideas in ways that drive impact. This early exposure provided me with a level of preparedness that allowed me to hit the ground running, contributing meaningfully to my role from the start. Upon returning to NAMRU-D for my first tour as an AEP, I found a handful of studies in progress and was appointed head of a newly established department on day one. Talk about taking to the skies—I was definitely busy!

In many ways, this postdoc served as a "sneak preview" of the challenges and opportunities I would encounter as an AEP. It gave me a unique advantage—an early immersion into the Navy's research world, where I learned how to navigate its unique systems, collaborate effectively with a diverse range of experts, and ensure that my research had direct operational relevance. This experience has shaped my approach to both research and

leadership, equipping me with the skills to thrive in a dynamic and mission-driven environment.

For anyone considering a similar path, my advice is to embrace opportunities like this postdoc—especially if they offer a window into the operational side of military science. While it may have been a short 10 weeks, the insights and skills I gained during that time continue to influence my work as an AEP, giving me the altitude needed for long-term success in the field.

MEET AN AEP

LCDR David "Popo" Rozovski, AEP #147, talks about his journey from grad school to the Navy

What is your Academic Background?

I went to high school in Santiago, Chile which did not have an international bachelors program at the time. Due to this, I was pre-Med through all of high school and spent all my summers and vacations at the hospital observing and even doing some procedures. Once I graduated, I realized I wanted to come back to the states where I was born and attend college. I continued with pre-Med but made the decision in my junior year to follow my passions of Aviation, Engineering, Medicine, and Psychology. I knew I didn't want to go clinical and Human Factors was a natural fit. As I wanted to focus on Aviation Human Factors, I started to pursue my licenses in fixed-wing and rotary-wing aircraft to build experience, understanding, and credibility. Upon graduating from my undergrad in Psychology at Linfield College, I got accepted to an internship with the Army at NASA Ames which led me to the University of Illinois Aviation Human Factors program. I did two internships with them and then after graduating got accepted to Purdue for the Ph.D. in industrial engineering program where I continued to focus on Human Factors. That summer I also worked at Boeing on the 787 flight deck design team and conducted my research at NASA Ames and the Canadian National Research Center's Flight Research Lab until I graduated.

How did you learn about the AEPs?

As I was getting ready to graduate, I thought about pursuing Medicine again and a friend of mine sent me a job posting for the AEPs. It combined everything I enjoyed and actually thought he had written the post as a joke. I had a call with one of the senior members and got hooked, best decision of my professional life!

What was the most challenging part of AEP training?

I would say my pilot training once I got accepted to the Aero Medical Dual Designator program which takes Medical Service Corp officers and trains them to be military pilots so that at the conclusion of their utilization tour, they can be more knowledgeable in their engineering job. While tough, I would say it was incredibly rewarding and met lifelong friends and mentors along the way!

What was your most memorable moment during training?

I think its two-fold, I have a ton of great memories that I hope to get to repeat and some life-long lessons that I hope I never have to experience again. For the great ones, it has always been the people followed by the aircraft. Throughout my career I have had the chance to fly over 65 different aircraft. Getting to meet different people from around the world while doing this, learning about them, their job, and the nuances of their airplanes has been one of, if not the most formative parts of my development as a Human Factors Engineer. As far as ones I don't want to repeat, I'd say getting spatial disorientation at night was also one of the most memorable, albeit on the opposite side of the spectrum. During one of my MH-60R Seahawk night flight deck qualifications where we land on the back of the destroyer to get and maintain currency. We were on approach to the back of the ship and ceilings were low and there was no visible horizon. We had Night Vision Devices but the light level was very low and were getting a lot of scintillation (i.e. static/sparkling). On short final I raised the nose of the aircraft to start my final deceleration and lost sight of the flight deck due to the pitch up attitude of the aircraft. At the same time, I felt we were still moving forward and realized I had spatial disorientation. I immediately called that I had vertigo and transferred the controls to my co-pilot. As soon as she took the controls I went heads down and started reading the instruments and realized we were actually moving backwards at about 35 knots and only about 15 feet off the water. Luckily we were well clear of the ship but the condition was not ideal. I immediately started verbalizing the corrective inputs to "add power and lower the nose" while guarding the controls to make sure it didn't get worse. We realized at altitude that we also had a flight control anomaly with turn coordination which we were able to resolve. My co-pilot did a fantastic job getting in the loop (i.e. back on the controls) and we were able to get up and away and set up mitigators to ensure it didn't happen. It was a great example of why crew coordination was and is so important.

What are you working on now?

I am currently the Technology Deputy and lead human factors instructor and instructor pilot at the US Naval Test Pilot School. It's been the highlight of my career, specifically the teaching and curriculum development. The billet has given me the opportunity to teach, fly, and learn which has been a dream come true.

Popo flying a form flight solo in the T-6B Texan aircraft.

Pictured above (L-R). LCDR David "Popo" Rozovski (AEP # 147), CDR Mark "Nard Dog" Sandeen (TPS Instructor), LCDR Joe "Beans" Geeseman (AEP # 147), LT Noelle Knight (AOP), LT Chris "Dora" Mecham (AOP), MAJ Kye "Touchdown" Colby, LT Sarah "Lil Debbie" Beadle (AEP #164), LT Joe DeRouchey (AOP) after a flight in the C-26 Metroliner at the United States Naval Test Pilot School.

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