CALL SIGNS

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A bi-annual publication of the US Navy Aerospace Experimental Psychology Society

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What kinds of lessons can you learn from 20 years of research and acquisition experience in the US Navy? We sit down with retiring CDR Jim Patrey, former AEP Specialty Leader, to look back on a storied carreer, and bid farewell to a fellow shipmate.

ABOUT THE COVER: LT Eric Vorm, AEP #149 coordinates the landing and delivery of US Marines for training at LZ Weaver during a sandstorm in a remote region of the Syrian Desert, Iraq, circa 2009. Landing in unimproved surfaces such as desert environments creates significant human factors challenges for aircrew and grounds crew alike.

CALL SIGNS is a bi-annual publication of the US Navy Aerospace Experimental Psychology Society (USNAEPS).
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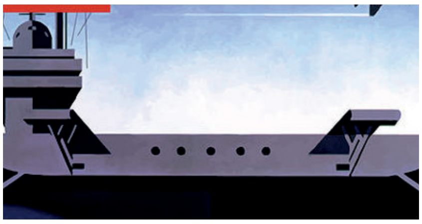


From the Editor

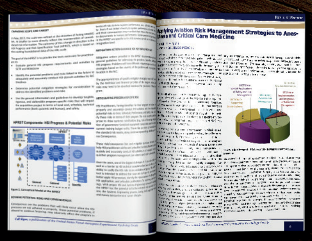
Greetings from the US Navy Aerospace Experimental Psychology Society!

This issue's theme is "Aviation Safety." Safety is an enormous topic of interest for military aviation, as well as the various aeromedical communities of practice, including the Aerospace Experimental Psychology community. Aviation may be the safest means of travel for the average person, but military operations introduce a higher level of complexity and risk that is not often addressed in non-military reports. As the pace of technology continues to quicken, and military aviation continues to grow and encompass other domains such as cyber security and artificial intelligence, the need for improved safety also increases. Ever since aviators took to the sky there have been challenges stemming from what is often referred to as the least predictable component on the flight deck: the human being. While technologies have come a long way in the past 116 years, the human factor remains as a source of potential conflicts that can only be mitigated with determined and resilient persistence from researchers and engineers.

In this issue of Call Signs, we highlight some of these challenges and the work being done by AEPs and other government-funded researchers towards addressing them. This issue is in fact packed with safety-related reports and stories addressing everything from human performance, to physiology, sensation and perception, safety technology, and future aviation safety considerations with automation. I hope you find the articles interesting, and maybe even inspiring enough to start your own project in Aviation Safety!

Aerospace Experimental Psychologists are uniquely qualified to lead the Aviation Safety mission for the Navy and DoD with our expertise in human factors and human-systems integration. So, let's get out there and continue to make a difference with our research, and keep our aircrew coming home safely!

Very Respectfully,
LT Joseph Geeseman, PhD, MSC, USN
Editor, Call Signs
AEP #148



CALL SIGNS

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Towards Ecological Visual and Auditory Cues to Support Spatial Orientation

By: Stephanie Kane & Ryan M. Kilgore
Charles River Analytics

Spatial perception in the cockpit remains paramount for safe and effective flight. Unfortunately, during visually intensive activities such as aerial refueling, maintaining accurate spatial perception is challenging. In these situations, the pilot is intensely focused outside of the cockpit and cannot move focus to reorient themselves on traditional heads down, foveal displays within the cockpit. When pilots are able to access cockpit displays, these displays typically present critical state information digitally over foveal vision displays. However, this format, frequently presented as text or display bugs on scales, is insufficiently compelling to compete with other “strong-but-wrong” pre-attentive sensory cues as it must be visually extracted, translated, and interpreted, which is a cognitive, but not perceptual task. Given the challenges of extracting useful motion cues from traditional presentation methods, the perceptual system falls back to other more compelling cues that easily out-compete available foveal stimuli but are subject to significant “strong-but-wrong” errors, such as spatial disorientation phenomena like “the leans.” Such decision aids insufficiently reduce pilot workload or improve safety during complex operations, as pilots may attend to more natural and compelling channels for orientation and motion information as opposed to visual cockpit displays, such as the attitude indicator.

Under a Navy Small Business Innovation Research (SBIR) effort, we are addres-

Flight crew over East Africa, July 24, 2018. Crews engaged in demanding activities such as aerial refueling encounter myriad challenges in visual perception and attention. Advanced techniques in visual and graphical displays are the key to promoting appropriate attention and vigilance on the flight deck. Photo by US AirForce Tech. Sgt. Larry E. Reid Jr.

A prototype used for experimentation. These displays use mixed modalities based on ecological interface design techniques.

sing these challenges by designing and demonstrating a set of multimodal ecological displays to enable efficient perception of spatial orientation through natural visual and auditory cues. As part of this approach, we are researching information display methods across multiple perceptual modalities, specifically visual and auditory channels, that place a minimal physical and cognitive burden on the already tasked pilot. These methods will remain robust to successful information transmission in challenging and dynamic operational conditions and the relatively noisy (sound, vibration, and illumination) cockpit environment. Designing interfaces to meet these requirements demands careful attention to specific cockpit interface modalities and the physical hardware configuration required to implement them. Cross-modal information displays can present information to the pilot along multiple sensory channels (e.g., vision, audition, touch; Oviatt, 2002). A key advantage of multimodal information display methods is their ability to improve the amount of information that can be conveyed to the pilot and the likelihood it will be perceived and responded to. Under this effort, we purposefully leverage channels and rendering methods that will be perceptually compelling and successful in cross-checking sensory illusions in specific task circumstances. For example, during highly visual tasks that demand the pilot maintain focused visual attention on their surrounding environment (such as aerial refueling or landing), status information may be presented through a non-competing perceptual channel (e.g., audio), rather than traditional heads-down display methods that demand focused visual attention (such as the frequently overlooked attitude indicator), thereby increasing the pilot's information bandwidth. When designed effectively, these displays will go beyond overcoming selective attention and provide compelling cues for changes in physical orientation and rates of rotational motion. A key part of our approach is that these methods will be judiciously applied in the perceptual context and consider the noisy cockpit environment. One important aspect of multimodal information design is the consideration of priority of perceptual channels, as some channels are harder to ignore information, especially conflicting information, more than others, thereby increasing the likelihood that the cue is received. In the example of a spatially disoriented pilot responding to compelling (but misleading) vestibular cues, contradicting audio cues may be more difficult to selectively ignore than data presented through foveal displays, making them more useful in combating misperceptions of orientation and motion.

We have applied mature ecological interface design (EID) techniques (Burns and Hadjukiwicz, 2004;) to develop auditory and visual displays. EID is an approach to perceptually grounded interface design that was developed specifically to address the challenges of cognitive work within highly constrained physical systems, such as pilot control of aircraft in flight. These displays aim to enable robust, direct perception and disambiguation of orientation and motion cues critical to maintaining awareness of the aircraft, in particular bank angle and pitch attitude. These ecological multimodal displays include a broad set of: (1) audio displays that utilized a non-competing perceptual channel to increase information bandwidth and overcome selective attention (e.g., such as pilots ignoring foveal displays for more compelling cues); (2) peripheral displays to overcome strong-but-wrong vestibular sensations; and (3) extended cockpit displays that translate typical on-axis representations HUD or VHUD representations (e.g., pitch ladders) to off-axis contexts, removing the need to look back down on-axis for orientation during maneuvers such as refueling.

To respect the visually intensive environment of the cockpit in refueling operations, we designed a range of auditory cues to leverage non-competing perceptual channels to increase information bandwidth and overcome selective attention (e.g., ignore foveal displays). A key part of our approach was exploring both spatial and non-spatial audio cueing methods to encode critical spatial information. As part of our approach, we leveraged orthogonal information display methods to show different information on different axes and redundant information displays to amplify transmission and improve likelihood of success. For example, one auditory cue employed a single looping tone where we redundantly encoded pitch and spatial location to map to the location of the horizon line. In this example, as the aircraft rolls to the left, the pilot hears the tone representation drop on the right side both in location and in pitch. The tone is presented on the right side of the pilot to implicitly indicate the corrective roll maneuver to return the aircraft to a level position. In addition to the horizon line, we explored cues to represent the ownship's roll. We also investigated combinations of audio tones to represent additional contextual information, such as historical roll or projected future roll, to implicitly cue the pilot to rate of change. Furthermore, we investigated the incorporation of reference information for relating roll information to reference points, such as providing an audio cue for level flight or the horizon line for quick comparison with the auditory cue representing current roll position. Across all of these display concepts, we employed a variety of tonal properties (tone, duration, pitch, volume) to create subsets of the information elements and aimed to cue the pilot to clear salient information displays.

With respect to peripheral displays, we designed methods that leverage peripheral cues to overcome strong-but-wrong vestibular sensations. Specifically, we explored methods to show key information through simple graphical shapes and emergent cues that grow with larger deviations, such as increasing bank angles resulting in the aircraft deviating from a assigned heading. A key part of this approach is leveraging strengths of peripheral view in detecting motion and employing animations, such as pulsing shapes or shapes growing in size, to highlight spatial orientation information and to remind pilots of their bank angle in prolonged turning maneuvers such as during aerial refueling. Some display concepts combined multiple methods. For example, one display concept provided digital horizon lines in the peripheral view of each eye that would increase in salience through size and opacity as the roll increases.

As part of our work domain analysis, we identified opportunities to build upon and expand heads-up-display (HUD) and virtual HUD (VHUD) interfaces to extend information within helmet-mounted displays (HMDs) and show additional information across the HUD/HMD. Early design explorations included extending the regime of the VHUD so that all or parts of the VHUD (e.g., pitch ladders) are available within a HMD when the pilot is looking up and out of the cockpit. While this information would still exist in a foveal display, it would be provided in a more relevant context that considers the physical viewable space during refueling, thereby removing the pilot's need to look down (and away from the refueling focus location) to orient themselves. As part of our approach, we explored a range of potential design solutions to extend traditional pitch ladder displays into the off-axis context and develop new display forms that convey critical information specifically tailored for the off-axis context.

As these designs evolved, we transitioned promising display approaches to prototypes of increasing fidelity and detail, both to support our own internal iterative review and incremental design process, as well as to support critical evaluations with our team of pilots. We explored a range of prototyping options, such as commercial off-the-shelf (COTS) see-through augmented reality helmets, which can support both head-tracking displays and spatial auditory capabilities. Head-tracking is useful to sense the transition between on-axis and off-axis displays, such as when the pilot is looking up outside of the cockpit to manage refueling activity. For our preliminary proof-of-concept prototype we leveraged the Microsoft Hololens augmented reality device as a primary hardware prototyping platform due to its rich, out-of-the-box support for head-tracking, 3D spatial audio capabilities, and rapid integration with our in-house flight simulation environment. However, one key limitation of the Hololens is the limited field of view. Because of this constraint, we utilized low-tech solutions for prototyping peripheral displays. Under our preliminary Phase I SBIR effort, we performed initial cognitive walkthroughs and informal evaluations of our display methods and preliminary prototypes with a team of pilots. Looking forward, we are currently designing formal evaluations under follow-on SBIR efforts to evaluate the usability, utility, and usefulness of these displays and overall approach.

Editor's Note: *This SBIR project is currently in Phase 2 executing human experimentation with the various display combinations highlighted in this article.*

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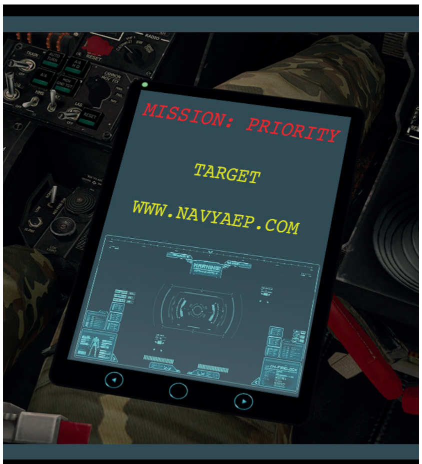


CAN PSYCHOLOGY HELP REDUCE AVIATION MISHAPS?

In the ongoing effort to quell preventable aviation mishaps, programs that characterize and address psychological factors stand to make the most impact. Here's why.

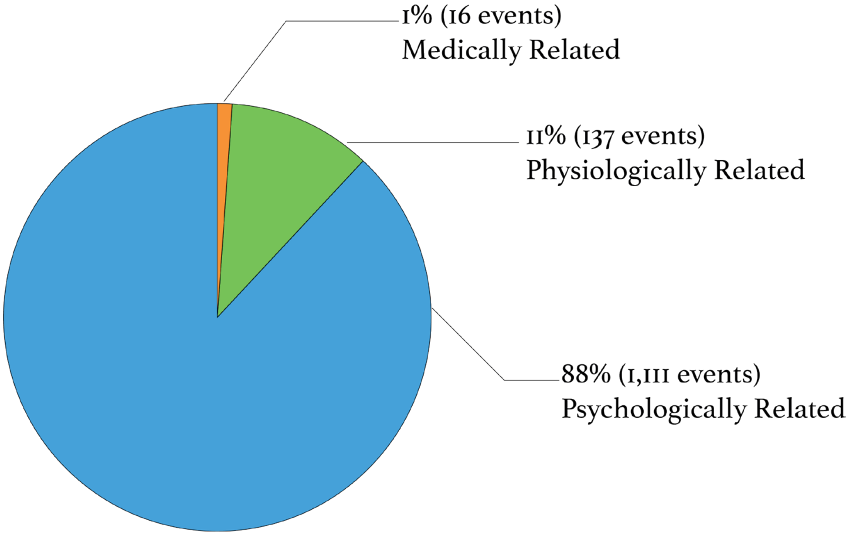
CDR Jim Patrey, CDR Noel Corpus

Arguably the most pressing issue in aviation safety is the role of human factors. Since the advent of the Human Factors Analysis and Classification System (HFACS) when root cause analysis could be consistently determined, roughly 75% of mishaps have involved human factors. Furthermore, over that same period, the mishap rate has remained relatively steady, with the Class A mishap rate generally 1-2 events per 100,000 flight hours at a loss of ~20 lives and $500M each year for Naval aviation. It is clear that the mishap rate has remained steady over the past 3 decades as has the role of human factors in mishaps.

Digging deeper into the human factors errors, it is clear that most of these errors align directly with Aerospace Experimental Psychologist (AEP) expertise. There were over 1200 instances in FY2011-15 of human factors causes in mishaps (all classes, with some mishaps having multiple human factors errors noted). Using the nano-codes from these events, they can be roughly grouped into three general human factors categories – medical, physiological, and psychological (there is certainly some overlap on the nano-codes between these human factors categories as well as some inconsistencies on how nano-codes are recorded, but this is deemed acceptable for a rough understanding of the patterns across these different human attributes).

If we take a look at the breakdown of each of these human factors-related mishap events, we see some very interesting and informative information.

One percent (16) of the HF events were attributed to medical origin, 11% (137) physiological in origin, and 88% (1,111) were psychological. This overwhelmingly skewed breakdown is not surprising when considering the presence of specialists in those areas – there are many more flight surgeons and a greater flight surgeon presence in the squadrons than there are physiologists and psychologists. Likewise, there are many more physiologists in the Navy overall, and a greater presence of them in the squadrons than there are AEPs, due in part to the Aeromedical Safety Medical Officer role currently shouldered by the aerospace physiologist community. In other words, it is entirely likely that the lower attributions of HF events to medical origins is related to the increased presence (and therefore mitigating potential) of flight surgeons, whereas the relatively fewer HF professionals such as Aerospace Experimental Psychologists in key fleet roles may be reflected in the increased prevalence of psychological-related mishap events.



Breakdown of 1264 Naval aviation mishaps involving human factors from FY2011-15. Source: Naval Aviation Safety Center data.

It would be incomplete to simply state that putting psychologists in squadrons will address this problem. While possibly beneficial, flight surgeons and physiologists have very specific duties that have proven to add value to Naval aviation safety, as demonstrated by the mishap data since those programs were implemented. Would such a thing exist were AEPs to assume a greater responsibility within the operational squadron's safety program? Possibly so.

Military and commercial aviation have slowly diverged over the past several decades. While the military has maintained a traditional approach of training aircrew on crew coordination behaviors, commercial aviation's approach has been evolving to include what is a safety audit approach within a risk management framework. Such a framework relies on understanding the many risk factors involved in flight and becoming highly-aware of how each of them are creating a cumulative risk that in combination with unavoidable human errors can lead to mishaps. In some ways this is consistent with the existing proactive Naval framework for aviation safety (Operational Risk Management OPNAVINSTR 3500.39C, Aviation Human Factors Management System per OPNAVINSTR 3750.6S and the Human Factors Board instruction COMNAVAIRPACINSTR 5420.2B), which each assert to pay close attention to "personal and professional circumstances which may interfere with an individual's ability to aviate effectively" (aka, psychological variables). None of these, however, have reduced the rate of human factors errors in mishaps, which suggests there remains a missing component.

Some have anticipated that the Military Flight Operations Quality Assurance (MFOQA) initiative would provide the data-based information needed to enable a robust proactive safety approach, but thus far it has failed to materialize for many reasons including the volume of data generated and the grossly inadequate analytical approach to handling such data (arguably not much different than the result from the commercial FOQA, precursor of MFOQA).

DoD Instruction 6055.19 (April 11, 2017) suggests that the Services develop a plan for implementing Line Operations Safety Audits (LOSA), a safety program currently in use with the airlines with much success, using a commercial vendor or following the guidelines found in Federal Aviation Administration Advisory Circular 120-90.

The USAF has already implemented this LOSA effort through AIR MOBILITY COMMAND INSTRUCTION 10-502 to generate a reasonable volume and meaningful quality of flight performance data to "discover common errors and threats aircrews face, and to determine the best practices employed by crews to mitigate and manage those threats and errors." This approach uses "diagnostic snapshots" – observations on a sample of flights – to generate an overall safety assessment (although note that successful LOSA use has been demonstrated on the ramp and in the hangar, not just the cockpit).

We know that the single biggest root cause in mishaps is psychological factors and the most successful commercial program not yet used by the Navy, LOSA, is specifically structured to address psychological factors, so it seems that the logical follow-on is how to adapt LOSA to fit Naval aviation.

The LOSA process requires both an observational and analytical team. For commercial aviation, it is simple to use qualified pilots as observers due to the small variation of the skillset and large number of commercial pilots and outsource the analytics. For the US Air Force, they have thus far limited their efforts to cargo aircraft due to their similarity to commercial aviation, and

The Line Operations Safety Audit (LOSA) program is currently in use with the airlines and has a proven record of improving psychological-related safety challenges. Efforts towards adopting LOSA for the US Navy are currently being discussed and debated.

have used reserve pilots for observations, and likewise outsourced the analytics. For the Navy, we could likely follow that model for our cargo aircraft, however, those are not the platforms that are driving mishap casualties and costs, so there is limited payoff for such an approach.

In order to address this gap for Naval aviation, however, we need an approach that addresses tactical missions. Unfortunately, the prevailing models are a poor fit given the diversity of Naval aviation platforms, and a scarcity of pilots available to serve in non-flying roles able to conduct observations compounds the challenges.

One resource that will be of value here are the AEPs, who are uniquely chartered to provide human factors analysis in support of safety. In fact, our charter specifically describes these duties: the mission of the Aerospace Experimental Psychology program is to ***"Analyze human factor aspects of survival, safety, and operational effectiveness of airborne weapon systems"*** (NAVPERS 15839I).

And because we are already directed to fly, it seems reasonable for AEPs to become LOSA observers. And because we are already skilled at observation and analysis, it likewise seems reasonable for AEPs to provide the analytical support to Naval aviation on the LOSA observations.

Of course, there are a host of empirical studies that need to be conducted so that we can determine whether or not the LOSA approach will work for the Naval aviation mission. This will have to happen before the program can determine who are the proper observers, what is the observation focus and locations (cockpit, ramp, hangar, etc.), and what the content of the survey tools to conduct LOSA, as well as the framework for providing analytical feedback should look like.

Although these first steps may seem like roadblocks, they themselves actually represent opportunities for AEPs, who will be critical to defining these features for implementation of a successful LOSA-based safety program.

Not since World War II has the need for AEPs to engage been as great as it is now to save lives, aircraft, and money for Naval aviation. Our great hope for our community is that we can embrace and pursue these opportunities in order to ensure that such mitigations to the preponderance of psychological root causes in mishaps are well documented, and quickly addressed.

A Navy X-47B Unmanned Combat Air System demonstrator aircraft prepares to execute a touch and go landing on the flight deck of the aircraft carrier USS George H.W. Bush (CVN 77) as the ship conducts flight operations in the Atlantic Ocean on May 17, 2013. This marks the first time any unmanned aircraft has completed a touch and go maneuver at sea. Unmanned aerial vehicles such as the X-47B currently fly in restricted airspace. Efforts are underway to integrate manned and unmanned traffic into the same airspace, but significant human factors challenges must first be addressed.

FLIGHT IN NON-SEGREG

Paving the way for fully integrated manned and unmanned airspace means addressing myriad challenges both technical and psychological- and that's just the beginning!

LT Eric S. Vorm

Present day headlines in military aviation safety are dominated by persistent physiological episodes in a variety of jet platforms. Teams of scientists and engineers are working around the clock as we speak, trying desperately to understand and model the problem in order to identify a solution. Like spatial disorientation in the late 1990s and early 2000s, or runway incursions and other carrier-based aviation challenges of the early-to-mid 20th century, this current challenge has the aviation (and the Aerospace Experimental Psychology) communities pulling out all the stops.

From the standpoint of aviation safety, it is an unfortunate reality that many of the issues we wrestle with only become apparent once an aircraft is fielded. A cost-based analysis would suggest that it is far easier (and cheaper) to address issues of safety while the aircraft or system is under development, when its components are somewhat malleable and receptive to adjustment. Despite significant investment in time and testing, however, many issues related to safety often go unnoticed or slip through the cracks during the run up to production.

As AEPs, we are often fortunate to serve at the bleeding edge of the acquisition of aviation systems. Remaining cognizant of the state of the science while keeping an eye on the horizon of development is therefore not merely a good idea, but a critical one as well.

This article introduces a relative newcomer to the aviation safety problem space: human-automation interaction. In it, I seek to inform readers of a potential near-term challenge in the development of a sense and avoid capability for unmanned systems to enable unmanned flight into non-segregated airspace. I outline the current and potential future challenges of the proposed systems design, and address possible areas where AEPs can provide meaningful impact.

As of the date of this publication, unmanned aerial systems (UAS) do not have dedicated airspace in which to operate, both in the US and internationally. Current FAA policy for UAS operations is that "no person may operate a UAS, including tethered UAS, outside of active restricted, prohibited or warning areas in the [national airspace] NAS without specific authority, with the exception of a model aircraft flown for hobby or recreational purposes or an Optionally Piloted Aircraft that has a pilot on board" [1].

There has been a great deal of effort extended towards integration of UAS into the full range of airspace for over a decade [2]. This is because a variety of UAS use cases and capabilities (such as cargo UAS, for example) are currently impeded by the inability to fly in non-segregated airspace. Amongst the variety of challenges that currently limit UAS operations to special, restricted airspace, the most applicable to the field of aviation human factors is the common requirement of self-separation.

Self-separation is a fundamental concept of aviation safety, originating from the earliest days of aviation before the advent of radar and modern air-traffic control. It remains a fundamental requirement of all aircraft, regardless of size or type. Current federal aviation regulations define this requirement as "when weather conditions permit, regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained

GATED AIRSPACE

by each person operating an aircraft so as to see and avoid other aircraft. When a rule of this section gives another aircraft the right-of-way, the pilot shall give way to that aircraft and may not pass over, under, or ahead of it unless well clear [3].” This defines the concept of ‘see and avoid,’ and is commonly known as the ‘remain well clear’ rule in aviation, which serves as the foundation of all right-of-way rules and regulations.

Because the pilot in command of a UAS is geographically removed from the vehicle, both the restricted viewing aperture and the pronounced latency involved in scanning via remote cameras means that they cannot accept visual separation or visual approach clearances [1]. Functionally this means that the responsibility for separation for all UAS (larger than 55 pounds) is assigned to the air traffic controller (ATC). This is a considerable problem because there are wide ranges of airspace that are not covered by ATC. The development of a system that could provide means of UAS self-separation without the use of ATC, therefore, has been a principal focus in the effort towards complete integration of UAS in the national and international airspace since the full-scale introduction of type 2 and above UAS [2].

Efforts to provide UAS ‘sense and avoid’ (SAA) capabilities (an adaptation of the ‘see and avoid’ concept from general aviation) have resulted in a variety of technological approaches. While these approaches differ in the methods with which the UAS detects and interprets potential intrusion threats, all prototype systems reviewed by this author have one fundamental factor in common: the extensive use of automation.

Virtually all group 2 or higher UAS make use of extensive libraries of automated routines and subroutines. These serve as functional macros to execute functions autonomously, and mostly work according to pre-scripted, algorithmic heuristics.

Many of these functions are not entirely dissimilar from the capabilities of many large commercial aircraft that utilize a flight management system (i.e., autopilot). In both cases, given appropriate operating conditions, a computer can provide heading and altitude inputs to the control surfaces, and can perform a variety of maneuvers, including takeoffs and approaches. These forms of automation, while not without their own challenges [4], are less worrisome, in part because many have been in operation for decades already with excellent track records.

The sort of automation proposed in future SAA systems, however, represents a significant leap in terms of the scope and authority these systems have to infer, decide, and act with little, or in some cases no human input. In order to understand both the human factors challenges presented by these types of automated systems, as well as the opportunities that AEPs may have in addressing them, it is first necessary to

LT Eric Vorm, AEP #149, pilots an MQ-9 Reaper UAV during a training event at Holloman AirForce base, New Mexico. UAVs such as the MQ-9 will hopefully soon be fully integrated into the national airspace.

define the problem space a bit more.

For the purposes of considering the human performance implications of automation, we can use a simple binary taxonomy to differ between the kinds of automation that (a) assists users in obtaining and maintaining awareness of their environment, and (b) that assists users in making decisions.

Automation that assists users by improving their awareness (herein referred to as 'situation assessment automation') does so primarily by integrating multiple data streams into consolidated displays, and providing alerts when systems are out of safe operating ranges. These systems primarily help users by allowing them to offload what would otherwise be additional monitoring tasks onto the computer, thereby freeing them to engage in more mentally demanding tasks (like flying the airplane). In the event that a decision must be made, the system generates some form of alert, making them aware of the situation. Common aviation examples of these systems include fuel level, airspeed, or stall warnings.

Automation that assists users by providing recommendations (herein referred to as 'decision support automation') does so primarily by fusing data from other systems with a heuristic evaluation of options, and then presenting those options to the user, often in a prioritized fashion, or in some cases eliminating all but one option. In the event that a decision must be made, because of the assistance of the computer, the user is able to arrive at a conclusion and act on that conclusion much more efficiently. Common aviation examples of these systems include traffic collision avoidance systems (TCAS), and the modern flight management systems (FMS) in most commercial flight decks, both of which issue alerts combined with some form of recommendation guidance (i.e., "pull up!" "pull up!").

At first glance, decision support automation has great appeal, and in many cases airline pilots have expressed a preference for these types of systems, mostly because of the cognitive efficiency they provide [5]. A granular comparison between the effects of decision aiding automation with situation assessment automation, however, reveals that the former can be problematic because of the way it can subtly influence human decision making.

Research has demonstrated that humans are more aware of a developing situation and their operating environment when they actually do an action as opposed to when they passively observe another agent perform the action (whether another human, or an automated agent) [6]. Researchers investigating this phenomena have observed that the mere act of generating an action (i.e., doing or deciding something yourself) rather than passively watching it being generated solidifies that action more robustly in memory— a phenomenon known as the 'generation effect' [7]. This 'see-do' dichotomy underlies the qualitative differences that systems providing automated alerts versus systems providing automated suggestions can have on human decision making.

In situation assessment automation, the user is provided an alert which directs their attention to a developing situation. They must then evaluate the situation, decide on a variety of options, and act. This represents the full cycle of human decision making, from input to output, which according to the theory behind the generation effect suggests that this results in a more solid understanding of that decision and its consequences in memory, i.e., greater situation awareness. In contrast, decision support automation provides an assessment of the situation AND recommends an action, which the operator then decides whether or not to accept or reject. In this case the operator does not benefit from the full sequence of decision making and so has a poorer understanding and mental representation of the system state and the consequences of actions, i.e., poorer situation awareness.

In emergencies, such as the ground collision avoidance example from earlier ("pull up") there is little concern that decision support automation can have a detrimental effect on decision making. But in situations that allow for anything more than an instinctive, reflexive judgement, there is ample evidence to justify concern, both from empirical research, as well as from mishap reports.

Several studies have demonstrated that users tend to perform better when utilizing decision aiding automation, but only when that automation is accurate and correct [8], [9]. When those recommendations are made incorrectly, either because of inaccurate system inputs or because the data on which the system derives its recommendations is fuzzy or probabilistic, then user performance suffers [10], [11]. As a real-world example, consider Air France flight 447. While transiting from Rio de Janeiro to Paris, the flight briefly encountered inclement weather which caused the pitot tubes to fill with ice for a short time. This in turn caused the speed indicators to read slower than actual speed, which caused the autopilot to register a stall warning, after which the autopilot disengaged (as it was designed to do). The pilots, unaware of the pitot tubes causing incorrect speed, misinterpreted the situation and, rather than responding to the stall warning appropriately, provided incorrect inputs which further destabilized the flight, causing a prolonged stall which ultimately led to the flight impacting the ocean. In this example, the computer incorrectly assessed the situation due to faulty data (incorrect speed caused by pitot tube impaction). Had the pilots been able to correctly assess the situation, they likely would have been able to notice that they were in fact not in a stall, and could have therefore made an appropriate decision not to interfere (it is worth noting here that the mishap report actually concluded that if the pilots were to have left the controls alone, the flight would have continued on without issue). Due to the added confusion caused by the automated alert and corrective guidance provided by the FMS, combined with the stress of flying in inclement weather, the pilots became confused and panicked, and their subsequent decisions ultimately lost the lives of all on board [12].

So what can be done?

Distinct from other human factors involving controlling UAS [13], the principal factor involved in developing an SAA system for UAS is addressing how to employ higher, more aggressive forms of automation in manners that do not lead to conflicts in human performance and judgement. Unfortunately, the kind of automation proposed in future SAA systems largely removes the evaluative component from the user, and therefore is more prone to lower situation aware-

LT Mike Natali, AEP #150, pilots an MQ-9 Reaper UAV during a training event at Holloman AirForce base, New Mexico. Training events such as these provide tremendous insights into the rigors and challenges that aircrews face on a daily basis. The role of UAVs in military aviation has expanded tremendously since being formally introduced in the modern era. AEPs and other researchers are hard at work developing techniques, strategies, and doctrine to help facilitate the full integration of UAVs into the national airspace.

ness and understanding of a developing situation [14].

Although up until recently decision support automation was largely only present in commercial aviation or nuclear process control, the promulgation of UAS, both in military as well as civilian dedicated airspace, presents human factors engineers (and by proxy AEPs) with unique opportunities to influence the future design of these systems in at least three following ways, starting from the bottom up:

1. Those involved in basic and applied research can continue to explore the rich domain of human-automation interaction, and in doing so can further identify risk factors, mitigation techniques, and design guidelines to help address these challenges.

2. Those involved in systems engineering, development and acquisition can provide inputs to the team, sharing lessons learned and helping to guide the acquisition and employment of decision support automation in future systems.

3. Those involved in doctrine can advocate for greater awareness of these human-automation conflicts (and for human factors as a whole). They can also serve to inform decisions related to a variety of policies including the training curriculum, as well as the higher level policies involved in how new systems are tested, evaluated, and fielded.

Conclusion

A number of indicators such as the UAS Roadmap [15] and the DoD's third offset strategy [16], among others, suggest that automation will be a near-ubiquitous element in most future systems.

From the standpoint of safety, it is in our collective best interest to get in front of these challenges and address them while they are still on the drawing board, rather than waiting until they are on the front pages of tomorrow's news.

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THE NEXT KNEEBOARD

Is Artificial Intelligence the answer to safely improving functionality and information in the cockpit?

Ben Bachelor | *Clinc*
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When devices and data are introduced into the command-and-control (C2) workplace, they frequently are not integrated by their developers into existing functions, data schemes, or work flows. The resulting spatial and functional cacophony can increase workload, distract, and create confusion. Devices and data may be widely distributed around the work area, making it difficult for operators to attend to their responsibilities. In high tempo operations, they may find it difficult to access everything they need when they need it.

Functions and data may also be distributed in depth, buried, or in nested menus where they can be even harder to find. Operators may find themselves searching for what they need and, more often they would like to admit, they may put off or even skip the process of stepping through a series of menus to change or check the status of a setting. In the case of a traditional cockpit, time aircrew spend searching menus and displays is time spent not scanning flight instruments or looking out the cockpit window.

A major conduit for bringing new functions and information into the traditional cockpit is the portable electronic device referred to as an electronic kneeboard (EKB). The EKB brings a variety of information and software apps into the cockpit. The data and apps are appealing in their potential to improve situation awareness, access to resources, and responsiveness to contingency situations, such as weather-related route deviations. EKBs can even benefit fuel costs: American Airlines, in 2015, estimated an annual fuel savings of at least 400,000 gallons based on the adoption of 8,000 iPads in lieu of each crew member's approximately 35 pounds of paper manuals, checklists, and charts (Pagliery, 2015).

However, the data and apps that are increasingly available for aircrew to load or stream onto their EKBs may not be explicitly developed to integrate with one another or with a particular workflow. Even worse, similar to apps on a typical smart phone, they may launch independently from a home page or toolbar. Even if a developer were to integrate the apps, they face the significant challenge of fitting all the information and functions into a small display space. This challenge is especially important to address in safety-critical and complex domains such as flight operations, in which display design must support rapid detection and response to a wide variety of anomalies.

Although EKBs have the potential to benefit aircrew, they come with the risks of increased workload, distraction, confusion, and head-down time. In an effort to mitigate these risks, researchers at the Department of Transportation's Volpe Center developed human factors guidance for the design of electronic flight bags (EFBs; Chandra & Mangold, 2000; Chandra et al., 2003). Their work contributed to the FAA's (2014) EFB design guidance, which applies equally to EKBs.

The FAA's EFB design guidance stipulates that there be no increase in flight crew workload or head-down time. It additionally calls out the need to integrate new functions and display items with the existing flight deck. In particular, it cites the importance of consistency in design philosophy and of developing procedures for deconflicting and coordinating the use of potentially conflicting information sources.

A recent study by Sweet, Vu, Battiste, and Strybel (2016) suggests that, although the design guidance may be helpful, designers continue to be challenged by the amount of functionality and information that must be squeezed into limited EFB display real-estate. Sweet and his colleagues examined reports filed in the Aviation Safety Reporting System (ASRS) from 1995 to 2015. They found 220 reports in which FAA-certified EFBs were reported as a contributing factor. In these reports, EFBs were most often cited for interfering with aircrew access to information, distracting aircrew, and adding to aircrew workload. Another commonly reported problem was inadequate training on the use of the EFB. The researchers also found that many reports cited difficulty using the zooming and panning features of the EFBs.

Introduction to PATELLA

The Pioneering Architecture Template for Flight Applications, or PATELLA, EKB is being developed to overcome two major limitations of EKBs and EFBs. First, PATELLA is designed to integrate the functions and information of multiple apps in order to avoid a disjointed user interface. Second, PATELLA is designed to overcome the EKB real-estate limitation by predicting and providing the functions and information that a pilot needs at any given time.

PATELLA will be an iPad-based data- and app-sharing system that allows aircrew to download apps and download or upload data feeds. The EKB is extensible and adaptable; new apps can be built and added in response to changes, for example, in aircrew mission and aircraft technology. The EKB is designed to give aircrew access to even more data products and apps than existing EKBs and EFBs. It additionally includes features that prevent those additional data and apps from adding to aircrew workload and head-down time. We describe these features below, following a brief PATELLA use case.

Use Case: Diverting to Another Airport

In this use case, an F/A-18 needs to divert to an alternate destination. Normally, an aircrew goes through a series of steps to determine where they intend to land, and this is a time-consuming process even if done pre-flight. If there

A crewmember using an electronic kneeboard (EKB) during a training mission. U.S. Navy photo by Mass Communication Specialist 2nd Class Daniel M. Young Released is a mid-flight emergency, a lack of fuel, or inclement weather, the time pressure can lead to less-than-ideal landings. In this case, however, the aircrew is using PATELLA. PATELLA's AI anticipates flight phase and associated aircrew needs. In addition, PATELLA meets those needs by drawing on aircrew-selected data streams and apps that meet certification requirements and conform to PATELLA's app and widget design specifications.

The aircrew begins the process of diverting when one of the aircrew selects Divert from PATELLA's Quick Launch Bar. A panel appears at the top of the screen and prompts the crewmember to enter key pieces of relevant information. PATELLA displays its estimate of the current fuel state, obtained from a fuel monitoring app, and queries the aircrew about constraints affecting the alternate landing zone choice. The locations of all nearby airports are now pinned on the map and color coded to represent whether or not they meet the aircraft's divert constraints. The co-pilot activates the projected-weather overlay and airport congestion estimates. She quickly considers each airport, identifying three as suited to the flight's constraints. She touches each of the three to obtain additional details and then chooses the airport that seems to qualify as the best divert location. Selection of the divert airport transitions the EKB to its Route view, where the pilot views PATELLA's recommended route on a map display. Air traffic control (ATC) transmits via datalink an altitude change and offers an expedited route. The pilot accepts and the new altitude and expedited route parameters are ingested by PATELLA and displayed on the route map.

The Landing support function launches automatically once the aircraft reaches a preselected altitude and distance from the airport. (Alternatively, a crewmember can manually activate it.) The Landing function presents information about the airport, including the approach plate for the assigned runway, relevant frequencies, and runway winds. The co-pilot selects the Notices to Airmen (NOTAMs) button, causing changes and warnings for the selected airport to be overlaid on the approach plate. She reviews all the information and then toggles directly to the Approach and Landing Checklists. As she executes the approach checklist, she uses PATELLA to mark off each completed item.

Safety Benefits

PATELLA is designed to support aircrew safety by minimizing the risks of increased workload, distraction, confusion, and head-down time. The main ways the design mitigates these risks are by:

Minimizing time spent looking for information. The PATELLA Intelligent Assistant (PIA) is designed to coordinate the presentation of apps, app data products, and other information to provide aircrew with relevant information and tools throughout the flight. To do so, PIA monitors the flight phase and, in the future, may monitor the status of flight instruments and equipment on the airframe. PIA is designed to function in the way Jarvis facilitates the Ironman suit in the major motion picture. It predicts aircrew information and support needs. It makes timely suggestions for courses of action, and performs low-level calculations so the aircrew can stay focused on the big picture. The aircrew would essentially gain an additional crewmember in PIA.

Minimizing time spent entering information. PIA activities depend partly on a Centralized Data-Sharing System. The data sharing system allows apps and PIA to obtain information from each other and from the other crewmember's EKBs. This reduces the number of aircrew inputs and enhances coordination between aircrew members. For example, an app for calculating wind-speed heading correction can query a Flight Planning app for the next waypoint and the difference between the current heading and ground track to accurately calculate a heading correction, thus removing several steps from the pilot's workflow.

Optimizing display element designs. PATELLA provides a framework and specialized EKB widget library to help developers build PATELLA-compatible, pilot-centered apps. By "pilot centered", we mean apps designed to take into account the competing demands for a crewmember's attention and the importance of minimizing head-down time. Widgets in PATELLA's app widget library will differ from the standard iOS widget library designed for use in everyday, general purpose, and recreational apps. They will be designed to take into account and minimize the effects of glare, vibration, and gravitational forces that could affect button-press precision. Given that widgets need to be visible from the EKB's location on the knee, their design will also accommodate a display-viewing distance that is greater than for typical iPad usage.

Drawing aircrew attention to easily overlooked alerts. The FAA uses NOTAMs to alert aircrew to runways closures, inoperable navigation aids, restricted airspace, hazards such as cranes near an airfield, and other recent and transitory events that have not been incorporated into official documentation. Of all the active NOTAMs, it is possible that none will be relevant to a given flight. As a consequence, aircrew do not always pay due attention and may fail to notice the occasional relevant NOTAM. To address this risk, PATELLA features a NOTAMs app that will automatically pull down, "read", understand, and recognize when a NOTAM is relevant to the flight at hand. The NOTAMs app will be capable of highlighting and annotating charts, maps, approach plates, and other standard kneeboard items to convey information found in NOTAMS. Some specific examples of how this could be useful include:

- Highlighting runway closures of the destination airfield.
- Displaying locations that are closed to taxiing on airport taxi charts.
- Highlighting valid taxi routes that avoid hazards or changes specified in a NOTAM so that aircrew can choose among them.
- Marking restricted airspace or other hazards, such as construction cranes near an airport, on maps, charts, approach and departure plates.
- Identifying degraded runway and taxiway conditions due to ice, snow or precipitation.

PATELLA's design must also take into account risks associated with using an EKB in an operational flight environment. Ejection while wearing an EKB is currently being investigated by the U.S. Air Force (2017). To date, this research has found that risk of an ejection injury is not higher when wearing an electronic iPad mini and shock case versus a paper-based kneeboard.

A flight crew of an F/A-18 prepares for a night training mission. U.S. Navy photo by Mass Communication Specialist 3rd Class J. Alexander Delgado. Released

The research team did, however, identify aspects of the EKB anchoring system that needed improvement. For both paper-based and electronic kneeboards, both a Velcro strap and a buckle clip strap had a tendency to slip and then slide down to the lower leg. They also noted the potential for either type of kneeboard to become dislodged by the windblast and strike the head or neck of the ejecting occupant. To mitigate that risk, the research team described plans to investigate a Velcro or buckle clip strap configuration that is further anchored using loops in the flight suit garment and a better side clamp system.

Looking Ahead

The PATELLA system was designed and prototyped during a Phase I Small Business Innovation Research (SBIR) effort sponsored by the Naval Aviation Training Systems Program Office (PMA 205). During the 2-year PATELLA Phase II effort, the Phase I concept will be developed into a fully functional system for EKB data and app management.

PATELLA development will benefit from regularly scheduled evaluation and feedback sessions with two to three F/A-18 subject matter experts (retired F/A-18 pilots with over 7,000 flying hours, more than 2,000 of which were flown in F/A-18s) and from evaluations conducted by a Navy pilot while sitting in the back seat of a Navy T-45 Goshawk during training flights. Both types of evaluations will help us to identify risks, develop mitigations, and assess those mitigations. They will focus on PATELLA's ability to support aircrew workflow, situation awareness, and responsiveness to events. Comparisons will be made between aircrew expectations and PIA actions to ensure PIA is operating as an effective teammate. Per FAA guidance, PATELLA will also be evaluated in terms of its functional equivalence to the paper-based kneeboard it replaces.

The success of PATELLA will depend partially on being able to offer its users a variety of PATELLA-compatible aviation apps. The Phase II effort therefore includes the development of the app widget library and actual apps, such as apps for preflight planning, route planning, taxiing, airport departure, and checklist execution. We, at Soar Technology, will continue to develop the PIA artificial intelligence technology and the NOTAMs app described above, while our partners at Big Nerd Ranch develop an initial base of PATELLA-compatible apps.

Conclusion

Professional aviation faces an interesting challenge as more and more functionality and data sources find their ways into cockpits and other control stations. These functions and data sources have great potential to increase capability and efficiency. However, they also have the potential to cause harm if not integrated in user- and work-centered ways.

PATELLA will play a critical role in addressing this challenge for the EKB by integrating loosely related apps, their information products, and real-time information feeds into a cooperative arrangement. By means of context-sensitive AI, it will pull apps and information from that arrangement to make them available to aircrew at times when aircrew most need them, providing adaptive work support to aircrew over the course of changing flight conditions. PATELLA additionally will enable the creation and sharing of new apps, eventually allowing PATELLA to have greater functionality than existing commercial applications.
The PATELLA framework organizes a changing set of apps and information within a framework that renders them both manageable and supportive of aircrew workflows. Our goal is to use the PATELLA framework, together with the safety-enhancing features described above, to produce an extensible, adaptable EKB system that supports aircrew in performing their work. PATELLA represents a new model for integrating the many changing components of modern extensible systems into cohesive, work-centered schemes. In doing so, it contributes to maintaining safety in the aircraft cockpit and in other C2 operations through the effective integration of new, valuable capabilities and information sources.

Editor's Note: *This SBIR project is currently in Phase 2 preparing to begin human experimentation and exploring additional use-cases in Naval Undergraduate Flight Training.*

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DEGRADED VISUAL ENVIRONMENTS

How quantifying visual attention may help improve aviation safety, especially when flying in difficult conditions

LT Joseph W Geeseman

During highly stressful tasks, “narrowing” of attention has been observed in military personnel in experimental paradigms including deep sea diving, parachuting, and during bombing missions (Baddeley, 2010). Helicopter pilots have also reported this experience, especially while attempting to land in a degraded visual environment (DVE). When pilots encounter a reduced visual environment, their visual scan is often reduced from their normal scan pattern. This means that pilots tend to focus on what is visible out the “bubble” near their feet, and consequently pay less attention to their flight instruments which can result in a devastating mishap. Poor surface composition and maintenance of landing surfaces often cause DVE, which has been attributed to nearly 5% of mishaps in the helicopter community (Dzamba et al., 1991). To address this issue, we are working to quantify the changes in visual scan experienced by pilots during DVE. Shifts in sensitivity and changes in response latency to visual stimuli used in a secondary task during flight will reveal decrements in functional field of view.

The “inverted U” function found with the relationship of physiological arousal and performance metrics has been established for some time (Hebb, 1955). This relationship suggests that as physiological arousal increases, performance metrics improve until a maximum level and then decline as physiological arousal continues to increase. Since the establishment of this function, investigations of differing optimum physiological arousal for different tasks have been more closely scrutinized. For example, the peak arousal for watching television will be different than the peak arousal required when engaged in combat. Following this line of reasoning, Baddeley (2010) investigated the influence of dangerous environments on the “narrowing” of attention.

Baddeley (2010) reviewed literature that investigated the decrement of performance on cognitive and motor tasks when participants were in dangerous environments (e.g., deep sea diving, parachuting) – he also scrutinized circumstantial evidence of increased performance errors found in data of bombing runs during WWII when danger was the most imminent. Although the current study does not directly investigate the influence of danger on performance, the simulated environment provides an approximation that can be extrapolated (Baddeley, 2010; Engstrom et al., 2005).

This research is unique from previous work, in that, rather than only focusing on measures of manual skills as demonstrated in the review from Baddeley (2010), this experiment evaluated attentional allocation by measuring changes in the functional field of view (Anderson et al., 2013). This is of particular interest because the data revealed the magnitude of decrement in the field of view of helicopter pilots landing in a degraded visual environment (DVE) (See Schwartz et al., 2005). This infor-

Poor surface composition and maintenance of landing surfaces lead to degraded visual environements (DVE), which are attributed to nearly 5% of mishaps in the helicopter community

A complete brown-out caused by a CH-53E heavy lift helicopter. Photo by LT Eric S. Vorm, AEP #149

mation, among the other recorded variables, provides a full spectrum of cognitive and behavioral changes unique to the challenges of landing a rotary wing aircraft under suboptimal conditions.

For this experiment, a high-definition CH-53 (i.e., large cargo helicopter) simulator provided a testing environment where two tasks could be investigated simultaneously – helicopter landing and a go/no-go performance task. For the primary task, participants flew a standard flight beginning approximately half a mile from a predetermined landing zone. On approach to the landing zone (LZ), the pilot would occasionally experience varying levels of “brown-out,” or the inability to see the ground during landing. This manipulation determined the level of difficulty for the landing task.

The secondary task was a go/no-go task, which is a common performance task used in psychophysical studies to evaluate response allocation under varying conditions (Nieuwenhuis & Yeung, 2003). In a traditional go/no-go task, participants are presented with two different stimuli (e.g., red dot and green dot) in series and are tasked to respond to one stimulus but not the other. The speed and proportionality in which the two stimuli are presented often lead to fluctuating degrees of success in this task.

For the current experiment, the visual cue comprised of a red number or letter randomly presented, in series, across the windscreen of the helicopter simulator. Participants pulled the communication trigger on the cyclic when they detected a number. The visual stimulus remained on the screen after a trigger pull, whether correct or incorrect. This manipulation prevents providing feedback to the participant in an attempt to reduce behavioral changes due to correct responses and errors. Four types of responses were expected for this task:

- Correct Response: Trigger pulled while number is present

- False Alarm: Trigger puller while no number is present

- Correct Rejection: Trigger not pulled while no number is present

- Miss: Trigger not pulled while number is present

The proportion in which these responses occur provides a number of metrics (e.g., sensitivity, criterion, receiver-operating characteristic curve) that quantify the “narrowing of attention” (See Green & Swets, 1966).

This experiment utilized varying levels of task difficulty for a primary foveated visual task and implemented a secondary peripheral visual task to reveal the extent of narrowing of attention. Williams (1982) indicated that functional field of view can be restricted by as much as 50% depending on the difficulty of a task. Therefore, longer response latency to target stimuli in conjunction with signal detection analyses of correct and incorrect responses should provide a compelling account for the quantification of narrowing of attention for helicopter pilots during landing in

DVE (Faust et al., 1999; Green & Swets, 1966, Posner, 1980). The results of this experiment will illustrate the changes in sensitivity to extraneous visual stimuli during a high cognitive load task (i.e., landing a rotary wing aircraft during DVE) that can be used in training and to motivate applied research. To achieve the objectives of this experiment, the following hypotheses will be tested:

1. Sensitivity to the secondary task will decrease as the primary task difficulty increases due to DVE.

2. Sensitivity to the secondary task will decrease as the primary task difficulty increases due to phase of flight.

3. Sensitivity will be higher to right visual field stimuli for the secondary task due to the pilots' seat position and tendency to use windows on the right of the aircraft for orientation to the ground than the left visual field stimuli during all conditions – left visual field sensitivity during 100% DVE leading to the least sensitivity to peripheral cues. Thus demonstrating "narrowing of attention."

4. A significant interaction of altitude, DVE condition, and visual stimulus location on response latency revealing that as altitude decreases and DVE conditions become more difficult, response times increase to the secondary task – with the slowest responses occurring for the left-most peripheral visual stimuli.

Methods and Procedure

Seven Naval Aviators completed the experiment for no compensation other than standard duty pay. All participants provided informed consent according to protocol approved by the Naval Air Warfare Center – Aircraft Division (NAWC-AD) institutional review board. Located in the Manned Flight Simulator (MFS) division of Naval Air Systems Command (NAVAIR), participants attempted to land an operationally equivalent CH-53 helicopter in a clear visual environment, a partially occluded visual environment (i.e., 50% occlusion by dust/fog), or a fully occluded visual environment (i.e., 100% occlusion by dust/fog) in a fully-counterbalanced design. The simulator included a high-fidelity cockpit, state-of-the-art visualization systems, and an integrated avionics environment.

Participants completed 20 trials consisting of approximately 800 secondary visual stimulus exposures, depending on how quickly trials were completed during each two-hour testing period. Each trail initialized with the aircraft already airborne at 800' approximately 2500' in one of six locations equidistant from a predetermined LZ. The simulated flight area was comprised of an airfield in which all the participants were familiar with navigating. Additionally, participants were instructed not to fly their usual approach pattern, but rather, fly directly to the LZ.

For each trial, a red letter or number covering approximately 1° of visual field appeared every 2000ms +/- a random interval up to 200ms. On a horizontal plane approximating eye-level, the ec-

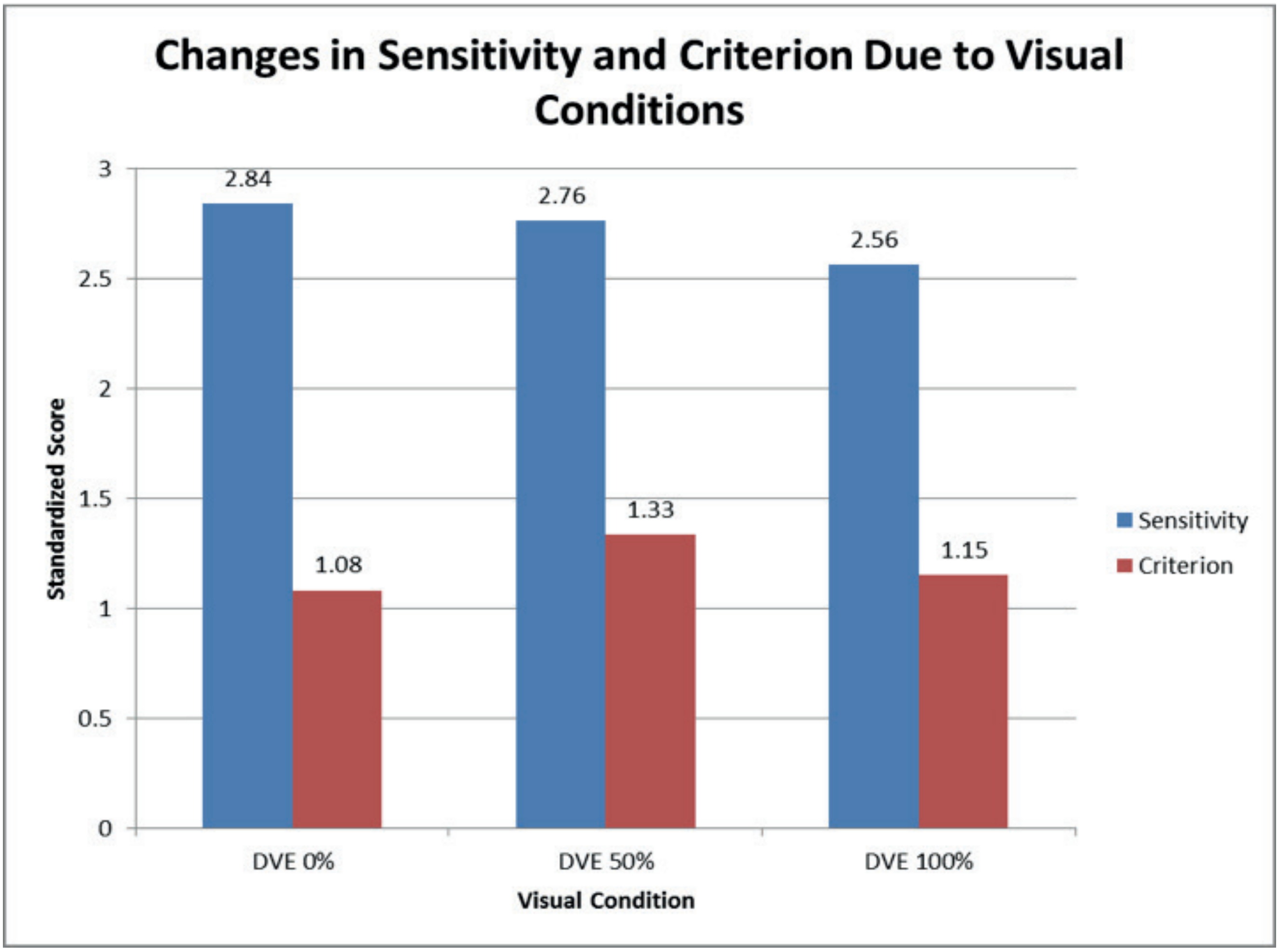

Figure 1. Increased difficulty in the primary task due to visual conditions leads to decreased sensitivity in the number detection task.

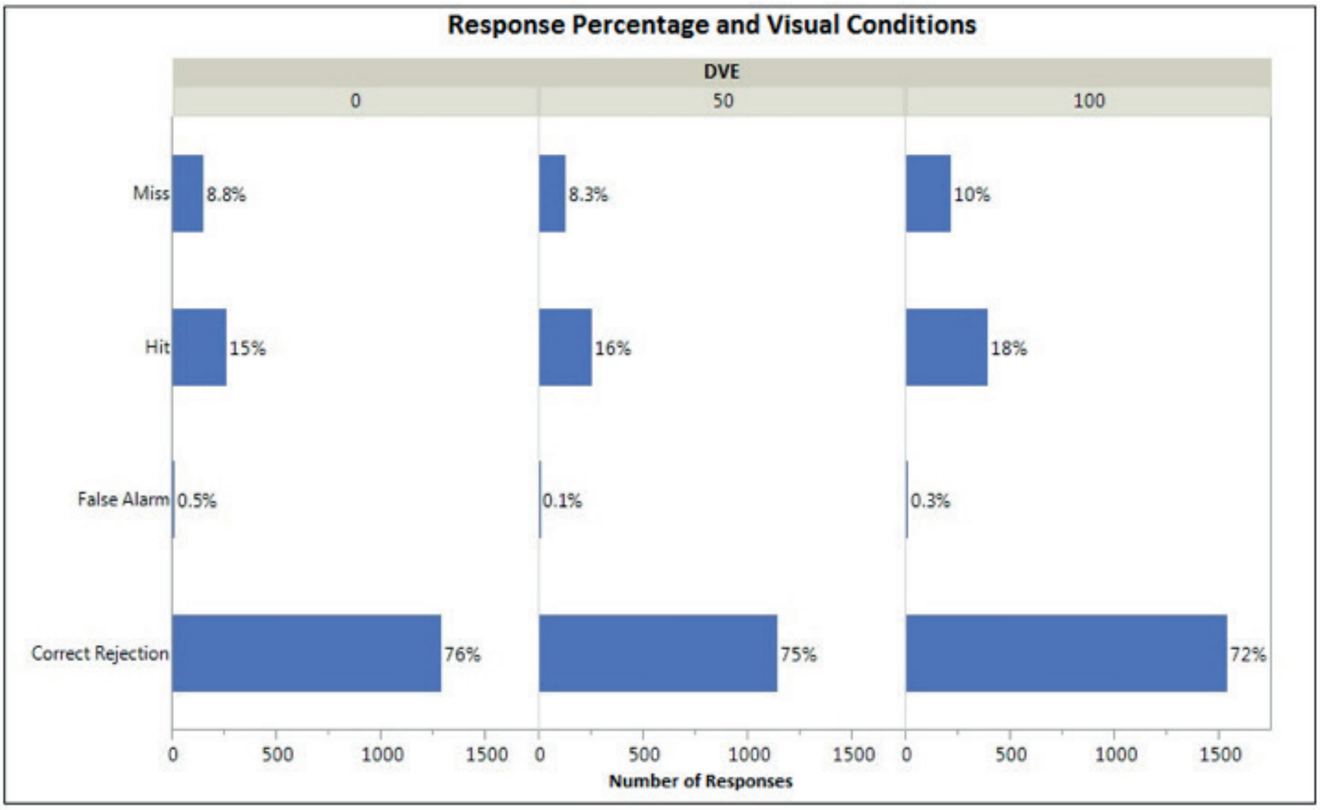

Figure 2: Response percentages change due to the varying visual conditions.

centricity of the visual stimulus varied about the center field of view by 10°-15° intervals to a maximum eccentricity of 25°. This experiment utilized a higher presentation weight for letters (75% of trials) than numbers (25% of trials).

The primary task was to land the helicopter safely in the LZ during varying levels of DVE previously described and the secondary task was to squeeze the communications trigger located on the cyclic when a number appeared on the windscreen. The simulator system collected data for two dependent variables during these tasks – correct/incorrect responses to the secondary task and response latency to the secondary task.

Results

The first three hypotheses refer to sensitivity changes to the visual stimuli due to several external factors related to the primary task, or flight environment. A test on the hit rate and false alarm rate for the number detection test revealed that DVE, altitude, and stimulus position all significantly influenced the distribution of responses. The number of stimulus presentations and response distribution are provided as well to clearly demonstrate how responses varied under different conditions.

As revealed in Figure 1, sensitivity to the secondary task decreased as the primary task difficulty increased due to DVE (χ2 (3) = 9.70, p <.05). The second hypothesis suggested that as flight phase became more difficult, sensitivity to the number detection task would decrease. This relationship was found to be true (χ2 (3) = 13.90, p <.001) with the number of target stimuli missed due to flight phase nearly doubling from 7% to 12%. The interaction of visual stimulus location and DVE condition was not significant as predicted in the third hypothesis (χ2 (3) = 5.76, p =0.12), though the data is trending in the predicted direction (see Figure 3). Although the interaction of DVE condition and visual stimulus location predicted in the third hypothesis was not found to be significant, visual stimulus location was found to be a significant predictor of response distribution. The final test revealed that the predicted interaction of DVE condition, altitude, and visual stimulus position on response latency was not significant, t(6) = -1.47, p = 0.14. Figure 4 shows this relationship and it can be seen that the data is trending toward the predicted interaction.

Two manipulations, however, influenced response latency – altitude and visual stimulus position. Response times to the secondary task increased as pilots transitioned from their approach to landing t(6) = -2.11, p < .05.

The visual stimulus position also influenced response latency to the secondary task, t(6) = -5.42, p <.001, and upon further analysis, it was found that a quadratic fit was best for this data [F(2,891) = 12.87, p < .001].

Discussion

This experiment utilized a difficult to access, state-of-the-art simulation system that up to this time was only used for training purposes. Due to the completeness of the system and the high-definition dust particulate, this experiment approximated the landing experience in DVE as close to reality as possible without testing in actual aircraft. The behavioral metrics collected from the participants very closely approximated those of live flight. One key difference between this experiment and live flight in DVE is the very high stress and true risk of serious injury or death if a landing is not executed correctly in an actual aircraft. During the experiment, 5-10% of the trials ended with the simulated aircraft rolling over during the 50% and 100% DVE conditions. Although the stress level was not quite that of an actual landing in DVE, the data affirmed several predicted hypotheses resulting in a more thorough understanding of the narrowing of functional field of view for helicopter pilots landing in DVE.

Signal detection theory is a common tool used to identify how changes in the environment or changes in a system influence the ability for someone to detect a stimulus of interest (Green & Swets, 1966; Posner, 1980). In this experiment, it was shown that a number of factors can influence the detection of peripheral visual cues when landing a helicopter in DVE. First, as DVE conditions worsened, participants' ability to successfully detect numbers for the secondary task decreased. Second, as the flight regime became more taxing, participants were less successful in detecting numbers as well. Interestingly, as the flight regime became more difficult and as DVE conditions worsened, detection and response latency to the secondary visual stimuli farther from center worsened at a greater magnitude. This relationship was not statistically significant, but the data is clearly trending in the predicted direction and further testing should reveal this relationship.

Other metrics may further support the thesis of this paper. For example, cyclic and collective movement may fluctuate under the varying levels of DVE demonstrating changes in attentional allocation. Eye-tracking methods could further support how fixations on instruments or outside the cockpit lead to narrowing of functional field of view. Only land-based trials were implemented in this experiment to maintain a manageable number of trials. Follow-up studies may investigate more dynamic environments, such as a moving littoral ship landing zone. Finally, collecting passive data while pilots fly training or operational missions would result in a clear quantification of the anecdotal evidence of pilots' visual scan changing during DVE.

Alternatively, further research may reveal other mechanisms pilots use in difficult flight environments to maintain situation awareness – the ability to process and maintain sufficient information about one's environment to act or react accordingly for the demands of said environment. For example, in a circumstance when a pilot does not have time to thoroughly scan multiple locations for relevant information about their flight environment, they may focus their gaze in a centrally located position. This visual search technique would provide the pilot with some information about multiple locations rather than a lot of information about one location and very little or no information from other locations (Eckstein, 2011).

With the advent of new technologies intended to provide visual information where the human system is deficient, this research provides a foundation for these technologies to advance as applied to, at the very least, rotary wing platforms. Additionally, the results of this project can be used to better educate student naval aviators during training. Data models provided by this research may also be used to guide the development of automated landing systems used in Firescout or other UAS platforms and during training of UAV operators.

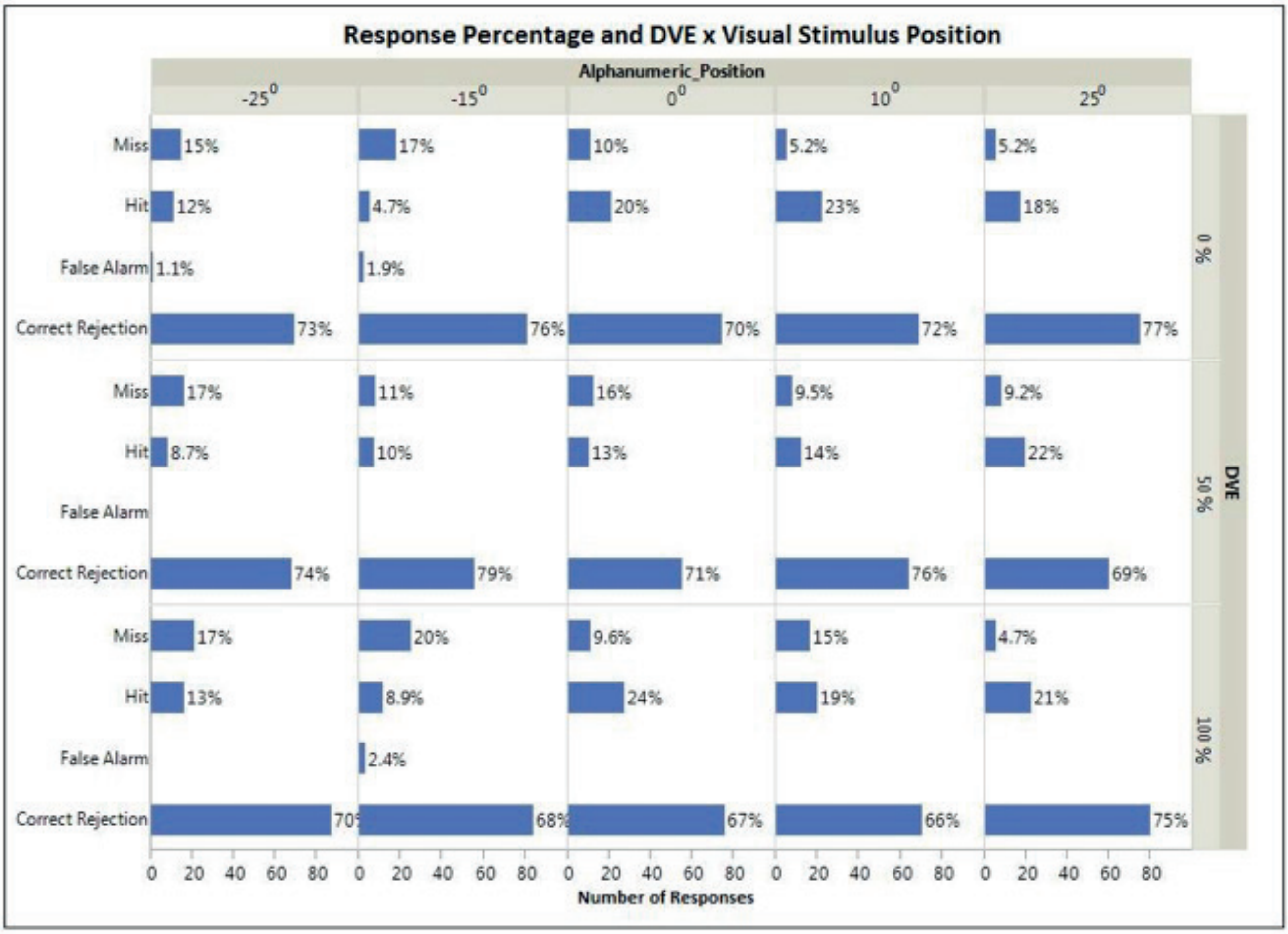

Figure 3. Although not a significant interaction, peripheral alphanumeric positions and higher DVE lead to a higher percentage of misses; lower percentage of hits; and lower percentage of correct rejections.

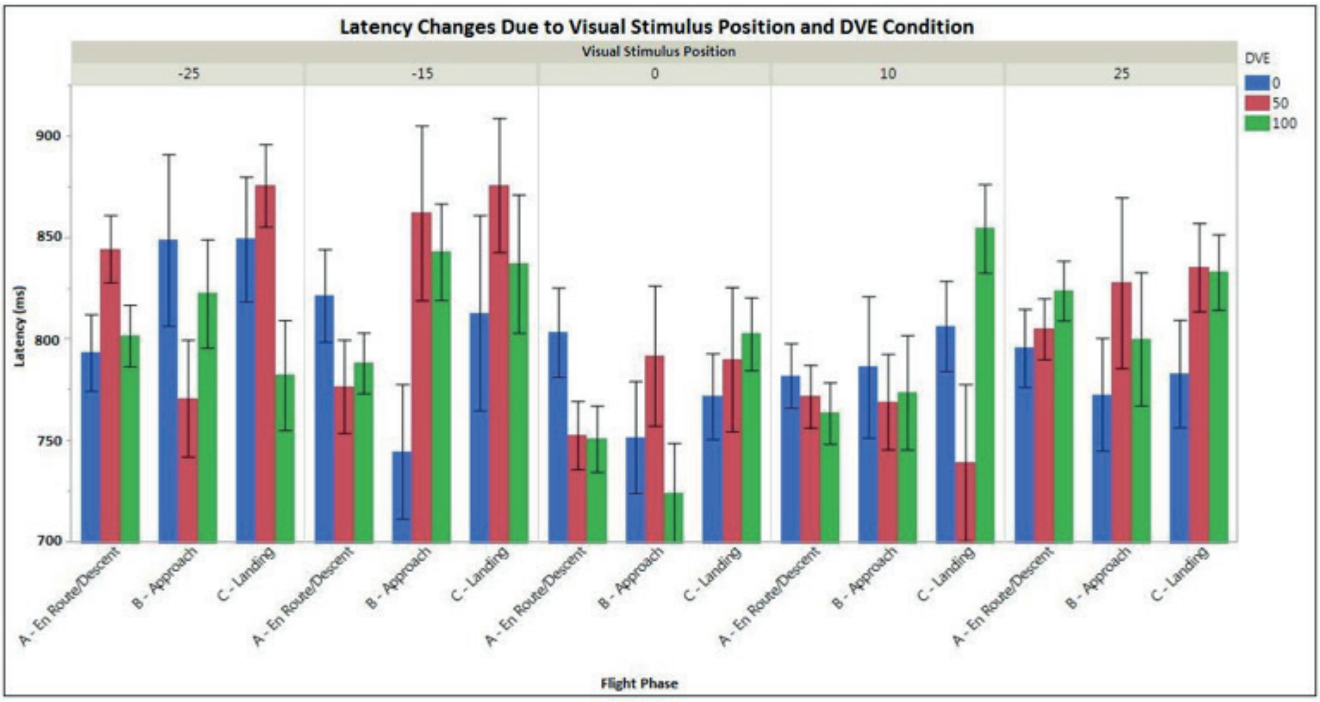

Figure 4. Response times are longer for the peripheral visual stimulus locations – landing phase of flight and DVE conditions (50% and 100%) increase response times more than the other phases of flight with clear visual conditions.

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THE SAFETY OF FLIGHT

A HISTORICAL NOTE

A brief look at some historical contributions towards aviation safety from early AEPs

CAPT (ret) Frank Petho, AEP #64

After World War Two, the number of active duty Naval Aviation Psychologists deceased precipitously; from about one-hundred at the height of wartime mobilization to less than ten in the late 1940s. By 1945, the cadre of senior officers and hence the leadership of the community had already left the Navy; most—40 percent—returned to academe from whence they came. Concomitantly, Congress created the Navy Medical Service Corps in August 1947 and by 1948, the Bureau of Medicine and Surgery (BuMed) named a Lieutenant Head of the bureau's Aviation Psychology Branch. Two other Lieutenants assisted him. By July 1952, there were twelve aviation psychologists on active duty, including nine at the fledgling Aviation Psychology Laboratory at NAS Pensacola.

In 1941, then personnel chief RADM Chester Nimitz established a class of officers designated as H-V(S) for Naval Aviation Psychologists. The H-V(S) psychologists exploited a methodological outcropping from a relatively obscure field in research psychology called "individual differences." The method they exploited was called the "numerical method" and it espoused using strict, verifiable quantitative methods to map the range and variability of human behavior in various settings. One of the first applications in Naval Aviation was to develop and validate tests to select aviators; tests which are still used today. The research was rigorous. Navy policy followed its conclusive findings. And after fleet-wide implementation, the policy's goal was achieved. Pilot attrition in flight training dropped significantly.

The War and its aftermath brought sweeping organizational and technological change. Aided by changing Naval

Aviation organizational structures and functions, comprehensive data collection and compilation techniques, and leavened by the raw computational power of new digital computers introduced in the late 1950s, Navy Aviation Psychologists extended the ascending arc of the “numerical method” beyond relatively straight-forward selection and classification applications into new and yet unexplored applications.

The reach of these quantitative applications is highlighted by a baseline observation made by a psychologist who in the late 1950s, was trying to convince BuMed and NAVAIR to rent a new IBM 1620 digital computer, of which only two existed at the time: “I had to convince 24 different BuMed and Naval Air Systems people … that renting the computer would be a good investment …. Of all those people I talked with, only one knew what a digital computer was.”

One such application was the broad field of operational performance research, which included a range of activities: from human performance modeling that could be used in the weapon systems acquisition process to help design, test, and evaluate human strengths and limitations, to untangling and clarifying the confounding, multivariate network of mutually interacting issues associated with “safety of flight.” These two tightly intertwined applications—operational performance research and safety of flight—continue to be the foundational sets of inquiry upon which the ever-changing billet trajectory of today’s Naval Aviation Psychology community rests.

As part of a Community of Practice, Naval Aviation Psychologists stamped an indelible mark on the field of Aviation Safety in the 1940s and over the course of 75 years, subsumed and broadened the scope and depth of its content domain. While there would be many examples of the “numerical method” applied during WWII, here are brief profiles of three early aviation safety pioneers who made their marks immediately after the war. Their unique contributions, which crossed scholarly disciplines and organizational lines, were made in the transition period immediately after the war, but their accomplishments and their attendant “lessons learned” have utility today. The three officers were ENS John P. Charles, ENS Robert J. Wherry, Jr., and ENS Norm E. Lane.

JOHN P. CHARLES

ENS Charles reported to BuMed in June 1951 and was quickly assigned to CNO’s aviation safety office before that office moved to Norfolk, VA in December 1951. There, the organization took a new name: the Naval Aviation Safety Activity, and ENS Charles was a “plank owner.” While at the Activity, he was put on aircrew status in 1954 as a technical observer and he and a Chief Navy Hospital Corpsman, ran the Medical Safety Branch. The Branch maintained reports of accidents and incidents, wrote articles for the Navy’s safety magazine, helped in accident investigations and analyses, and coordinated with other aviation safety medical offices throughout the country.

Charles statistically analyzed accident data to isolate causal factors, and studied human involvement, safety equipment, and mortality data of insurance companies. He created an accident exposure index based on accident data and flight duration by phase. He also refined the definition of an “accident” in terms of its consequences and created the “incident” which produced a more meaningful look at the current “accidents.” The revamped accident figure changed for the better, but an intractable problem—to this day—was trying to measure “pilot error” which was a sensitive area among the staff of pilots in the office.

He reported to the Bureau of Aeronautics in September 1958. In September 1962, Charles reported to the Naval Missile Center at Point Mugu, California and was assigned to the Human Factors Section in the Laboratory Department. Also in 1962, for the first time, the Navy formally recognized the role of human factors in weapon system design with the publication of MIL-H-22174 (Human Factors Data for Aircraft and Missile Systems), which was written by John Charles. Charles was eventually relieved by Robert J. Wherry, Jr.

ROBERT J. WHERRY

Wherry was commissioned a Line Officer in 1956—he served 18 months aboard USS Strong (DD758)—and later, because of his operational experience and professional interests, cross-decked to the Medical Service Corp in 1958. His shipboard duties included Anti-Submarine Warfare officer, Fire Control officer, Torpedo officer, Assistant Gunnery officer, and Officer of the Deck (both underway and in port). He led two divisions of enlisted personnel who were responsible for maintaining and operating complex sonar and fire control equipment and several types of weapons; for example, torpedoes, 35 mm and 5 inch gun systems, depth charges, and other emerging munitions, such as a forward-throwing anti-submarine weapon called the “Hedgehog.”

After transferring from the Line navy to the MSC to become a Naval Aviation Psychologist, he served as a research psychologist at Naval Air Station Pensacola for two tours, with a one-year absence to work on his doctoral degree at the Ohio State University.

He had a strong academic background in multivariate statistics and human factors engineering. In the early 1950s, as an undergraduate student, he held a summer job for two years in Paul Fitts’ Laboratory of Aviation Psychology at Ohio State University. In 1962, he took a graduate level course in experimental design from George Briggs, who had taken over the Aviation Psychology lab after Fitts left for the University of Michigan in 1958. He also had taken two other graduate level human engineering courses and was well experienced in measuring and analyzing human performance data.

In September, 1966, the Bureau sent Wherry to lead the Human Engineering Branch of the Systems Integration Division at the Naval Missile Center, at Point Mugu, California. The idea for creating the Human Operator Simulator (HOS) began there in 1967. The original purpose of HOS was to create a unified model of a human operator which, through computer simulation, would accurately, quickly, and reliably estimate the time required by pilots and aircrew members to perform the perceptual, cognitive, and motor skills needed to meet complex aircrew job requirements.

The rationale to develop a way to quantitatively validate the dominate method used to assess and predict human operator performance during weapons system acquisition — task analysis — was straightforward. It stemmed from two suppositions. First, static paper-and-pencil selection tests failed to tap into aircrew skills needed to accommodate dynamic information processing situations. Second, most performance time data that existed for dynamic tasks (like complex


LT Elergy L. Stromberg (Left) explains speech psychology lab equipment to Rear Admiral Osborne B. Hardison, chief of Naval Air Primary Training, May 1945. Early pioneers in Aviation Psychology like LT Stromberg led the way towards enhanced safety and improved selection of aviation personnel during the formative years of Naval Aviation.

tracking, multiple signal monitoring, extrapolation of changing data, target recognition, rapidly shifting attention to other active tasks in a rational way, and carrying out a series of steps in complex procedures) had been collected when subjects only had that one task to do.

Over its years of development, designers used the model to configure the physical layout of cockpit displays and controls, to automate pilot tasks, to define a standard way to assign tasks to human operators in manned systems, to produce guidelines for the development of legible and understandable display and control labeling, to model the machine-part of the human-machine system, and to provide useful human factors data outputs and analyses. Interestingly, as with other applications of the “numerical method,” this work proceeded on an empirical, non-theoretical footing: the statistical methods of factor analysis and multiple correlation provided the basis to predict performance times and accuracies, understanding underlying mechanisms or processes involved in those acts notwithstanding.

Wherry retired from the Navy in 1976, and started his own company (The Robert J. Wherry, Jr. Company) and worked as the prime investigator of a Navy project to develop computerized ways of understanding the meaning of spoken English sentences by aircrew members. In 1978, he became a subcontractor to a human factors engineering company, and worked on many different HF programs some of which involved potential enhancements to HOS.

NORM E. LANE

ENS Lane reported to the Aviation Psychology Laboratory at the Naval School of Aviation Medicine in 1963. He had a master’s degree in experimental psychology from the University of Florida, taken under the direction of a former Naval Aviation Psychologist Marshall Bush Jones, who, coincidentally, had also been stationed at the Pensacola Laboratory as a Lieutenant Junior Grade in the early 1950’s

Norm selected Ohio State University to study for his Ph.D. in experimental psychology and statistics. He earned his degree under the direction of Dr. Robert J. Wherry, Sr.. Several other Naval Aviation Psychologists also gravitated to OSU in the 1960’s: Robert J. Wherry, Jr. (#8), Charles W. Hutchins (#20), John C. Ferguson (#25), and James H. Ashburn (#26).

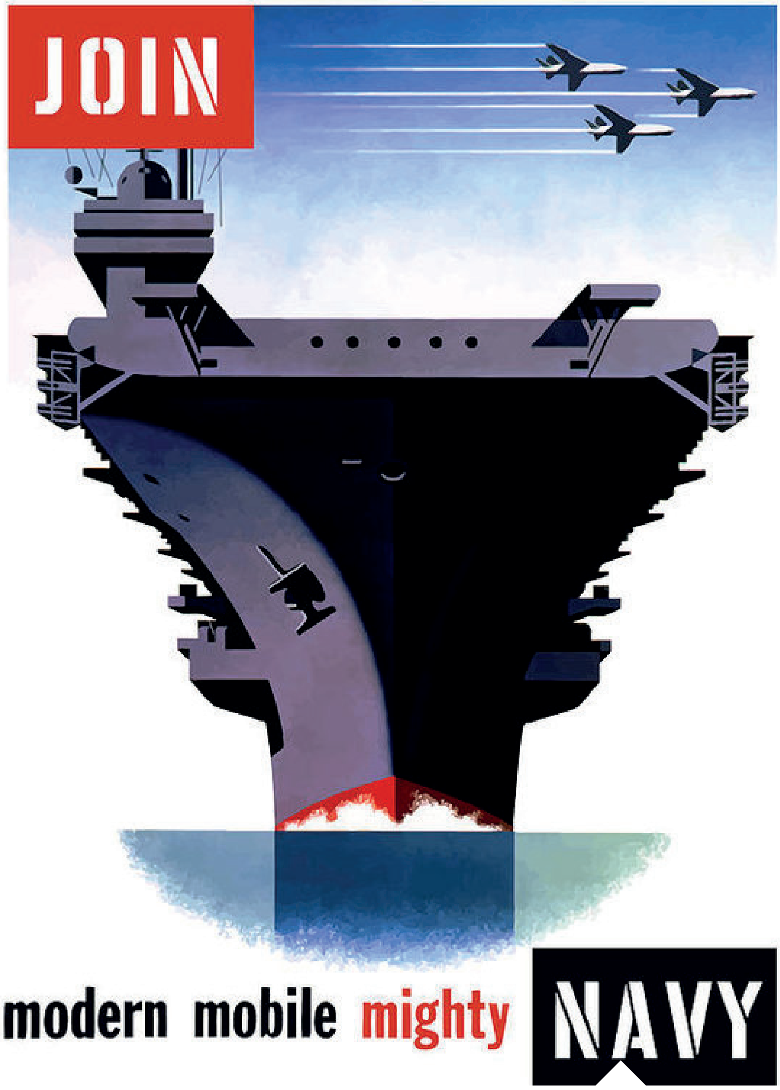
While he was in the navy, Norm published over 60 academic papers. Most of his early publications were concerned with statistical analysis, prediction of flight performance by naval aviators and other ancillary issues. Seven of his most enduring contributions to the safety of flight included a comprehensive review of naval aircraft mishaps that involved human engineering design deficiencies; a compendium of anthropometric incompatibilities especially as they related to female anthropometry and cockpit geometrics; a statistical review of Navy diving accidents and injuries; the adverse impact of aircrew fatigue on extended maritime patrols; differences in accident potential for first and second tour helicopter pilots; leg injuries in A-4 aircraft in relation to buttock-knee and leg lengths; and the relationship between pilot experience and pilot-caused carrier landing accidents. Perhaps his most exhaustive and enduring contribution to safety of flight was a seven-volume functional analysis of the in-flight tasks, duties, and roles of Naval Flight Officers.

After retirement from the navy Norm worked for Essex Corporation for 15 years. Among his unrivaled accomplishments were papers on “Human Performance Assessment” and “Evaluation of Military Training Systems.” He also did a large sample (N=1,600) factor analysis of simulator sickness symptoms.

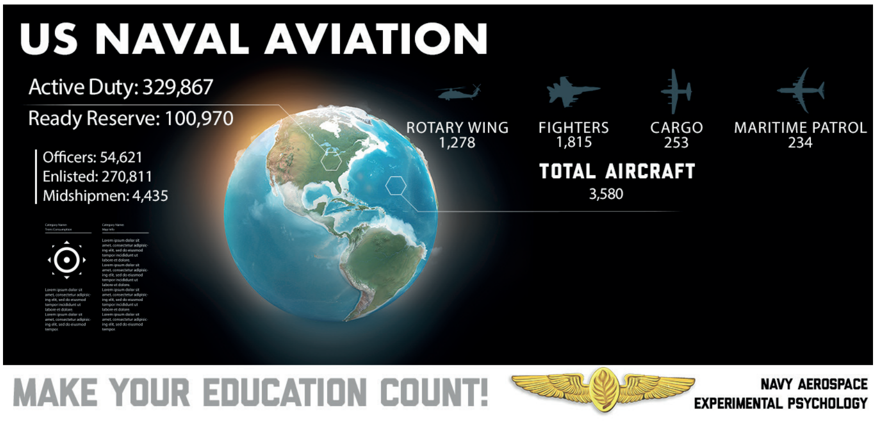
Before Norm had open-heart surgery at the Bethesda Naval hospital, his family discovered that he had trained the cardiology staff on how to calculate the probabilities of his survival in terms of which arteries were blocked. Norm survived and retired from the navy as a Commander.

Upshot. The General Case and Specific Instances. The general case is that the fruits of inquiry into Safety of Flight and Naval Aviation Psychology (1) stem from a joint enterprise, inextricably fused in mission and method and (2) that that fusion has operated efficiently and productively for over 75 years, if not more. For example, in 1919, Captain D. W. Knox’s (USN) report on a General Line Course of Instruction for Officers recommended a continuum of education for naval officers. An overarching theme in that report was its then bold intent to fuse advanced education with practical experience.

The profiles of ENS Charles, ENS Wherry, and ENS Lane document three specific instances of that fusion between advanced education and practical experience. The yield is dramatic. ENS Charles produced a military specification for human factors in weapon system acquisition, whose successor policy statements exist today. ENS Wherry stimulated scores of researchers to use computers to model human operators and to use the results to help design cockpits of the future. And, ENS Lane, using data from the field, advanced statistical inquiry into complex multivariate analysis to address both idiographic and nomothetic levels of study. Who could have predicted the fruits of this fusion?



Recruiting poster for the US Navy, circa 1943.



MEET AN AEP

In this recurring series, we interview new AEPs to learn about their backgrounds, what motivates them, why they chose to serve in the US Navy, and what kind of work they are doing to help our warfighters tackle today's most pressing problems. In this edition, we meet LT Claire Modica, AEP #157.

What is your academic background?
Academically, I am a biomedical neuroscientist with experience in neurodevelopment, pathology, and degeneration, glia, cell signaling, mammalian disease, sensory perception, and the neurological basis of behavior.

Personally, I am a New Yorker through-and-through, growing up on Long Island (plus a bit of Queens), then attending college in Manhattan and grad school in Buffalo.

What made you interested in pursuing a Doctoral degree in neuroscience?
I conducted an independent study in high school under the mentorship of a psychology teacher. The study included consent forms, permission slips, confederates, and validated, reliable pretests and posttests. We supported our hypothesis and won second place in a science fair. The results helped

All in the family: LT Claire Modica, AEP #157, and her brother, Marine 1stLt Alexander Obremski, pose for a selfie at the National Naval Aviation Museum in Pensacola, Florida. 1stLt Obremski is a student naval aviator currently in Helicopter Training Squadron 28 in Milton, Florida - the same squadron where LT Modica completed her rotary wing training.

inform curriculum at my school, and I learned that science can enact change. I have wanted to be in research ever since. When I was later introduced to behavioral neuroscience and human biology, it drove my enthusiasm for biomedical sciences.

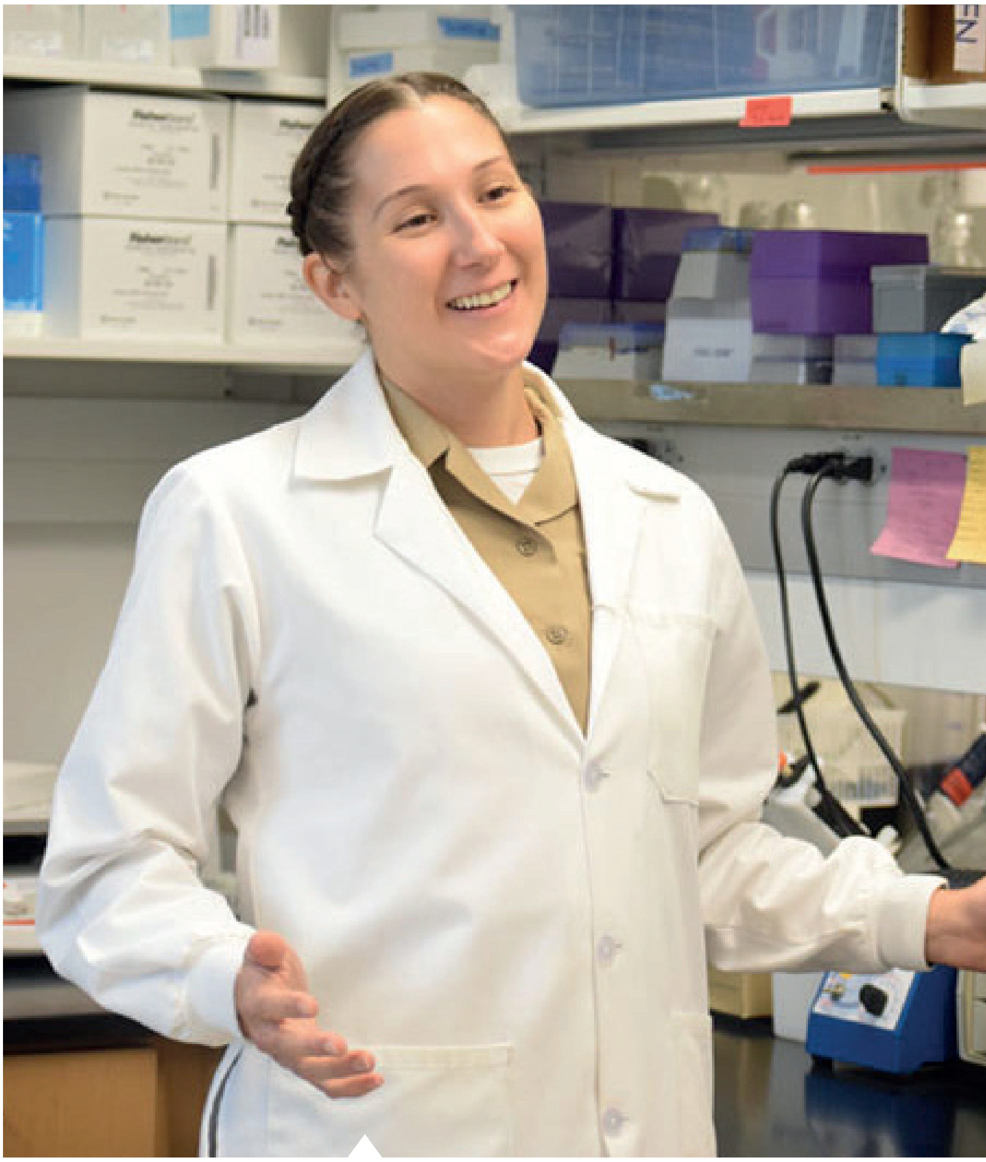
How did you learn about the AEPs?
While in grad school, my brother gave me the idea of inquiring as to whether the military had need for neuroscientists. A Navy recruiter told me about the AEPs. The more I learned about the community, the more I knew that I did not want to do anything else.

What was the most challenging point of AEP training?
More than anything else, time management was the skill I exercised most. There was a lot of work and studying to do. Coming out of a biomedical PhD program was good preparation. However, instead of work generally focused in one area, the tasks in training were largely varying. Additionally, instead of 6 years, the abbreviated aeromedical flight curriculum afforded closer to 6 months to accomplish them. On top of studying, there was swimming, physical training, acclimating to the flight environment, and coordinating moves of household goods with a spouse in another state, all while making time to foster camaraderie in relationships with sailors and marines that may last my career.

What was your most memorable moment during training?
My fondest memory of training was when my brother winged me at my graduation ceremony. He is a former enlisted Marine and we were both in aviation training at the same time. We are very close and he is at the heart of one of the most compelling reasons behind why I continue to want to be an AEP. It can sometimes sound like we speak about the warfighter or the aviator in hypothetical terms, but he is real, as are others like him. Instead of pursing tenure in academia or wealth in industry, I have found the height of fulfillment in my work comes from supporting those who defend our nation.

Where do you see yourself in 10 years?

I have come to think that I may like to participate in shaping policy, particularly at the medical level, but I would need to explore training or education in that area first. In terms of research, inspired by the applications of neuroscience in prosthetics, I would love to explore a connecting medium between neural tissue and technology to expand, rather than restore, capability. For now, I am focusing on being flexible to fulfill the needs of the Navy.



LT Claire Modica, AEP #157, applies her expertise in neuroscience at the Naval Medical Research Center (NMRC) in Silver Spring, Maryland. NMRC conducts medical research, development, testing, and evaluation to develop new information and technologies to enhance the health, safety, performance, and deployment medical readiness of Navy and Marine Corps personnel.

FAIR WINDS, FOLLOWING SEAS

What does 20+ years of Naval service as an Aerospace Experimental Psychologist look like? We get up close and personal with CDR (retiring) Jim Patrey, AEP #110 to discuss his experiences, lessons learned, and why he loves hot dogs.

CDR Jim Patrey joined the Navy in 1997, and was winged as AEP #110 on April 15th, 1998. He served in a variety of duty stations and roles, including serving as AEP specialty leader from 2013 - 2017. We sat down with him on the eve of his retirement to discuss what he has learned from 20+ years in the Navy, and take a look at his remarkable career.

What made you want to become an AEP?

As I was finishing graduate school, I was struck by the realization that there were a handful of people in the world that would care about my research and it didn't lend itself well to a positive impact - that wasn't the direction that I envisioned for my career. I had worked for a professor's side business looking at very applied issues (the shape of sunglasses that would sell in Asia, how quickly someone could remove a fire extinguisher) and those were more compelling for me. I had seen advertisements for the Navy AEP positions (think it was in the APA Monitor via another job site) and that intrigued me enough to pursue it. It was then-LCDR Sean Biggerstaff and CAPT Mike Lilienthal that well represented the community; I distinctly remember Sean's practical comment as to it being like a 3 year post-doc with much better pay and aircraft – with post-docs then not breaking $20k/year, that was a great selling point!

Looking back to your early career, were there any moments that stood out as shaping your career path?

Ships, planes, and hovercraft (bad word play on the "Planes, Trains and Automobiles" movie). Flight school was informative in understanding the difficulty and perils of aviation, but gaining experience and understanding of operations aboard ships, flights, hovercraft, and such was much more valuable towards understanding what our specialty could add to safety and performance for operational missions. I don't think I learned that lesson as quickly as I would have liked, but I eventually realized that the best work our community does and has ever done isn't published in a peer-reviewed journal, but rather is resident in our operational systems and warfighters and best reflected in bombs-on-target and warfighters returning home. There are aspects to mission success and safety for which only AEPs can sufficiently address.

Did you have any mentors that helped shape your leadership style? How did they influence you?

I have been privileged to have many great leaders to follow, model, and seek advice. At my first tour, had a great skipper in CAPT Jay Hixson who bothered to spend a little time with me as well as my supervisor AEP LCDR Karen Hyde (who taught me the priceless saying "If you wrestle with pigs, you're gonna get muddy" and gave me good reason to learn to walk away from foolish in-fighting and politics), through my last command where RDML Shane Gahagan and VADM Grosklags were voices of wisdom and sanity in an environment often devoid of both. Within the community, it's probably overkill to laud CAPT Lilienthal as a valuable mentor, but just can't omit him as I have rarely seen anyone, anywhere (not just in the Navy), so selflessly invest himself in others; to have served with him and count him as a mentor is a treasure. Likewise, I was able to learn a great deal from my peers and friends, such as CAPT Dylan Schmorrow and CAPT Joseph Cohn over years and beers. But I have to give credit to my first civilian supervisor, Dr. Robert Breaux, above most – there is little that I've encountered in my career for which he hadn't somehow prepare me for in some fashion or another; many found him difficult as a mentor as he rarely answered a question with a straight answer (what was called a "Breaux job"), but he was perfect for me as he guided me through problems rather than telling me an answer so not only did I find a good answer (eventually), but developed good means for solving problems in general.

Over your career, how has the AEP community changed and where do you see opportunity for the future of the AEP community?

Hard to gauge whether the AEP community has changed during my time; circumstances and environments have and the Navy continues to evolve around us, but many of those with a longer perspective note how the pendulum swings and different priorities, challenges and such become a focus then fade. For example, an emphasis on Navy Medicine seems to wax and wane and does require a delicate balance to properly weigh what AEPs need to do to support our mission ("human factor aspects of survival, safety, and operational effectiveness of airborne weapon systems") against what AEPs as Sierra-Hotel thinkers and achievers can do for Navy Medicine. To me, one significant change I've noticed is that it seems that we have crossed some boundary in what I've seen called "Wisdom Warfare" – it's no longer enough to have a functional machine and a skilled operator, but rather warfighting is evolving to emphasize the highest levels of expertise with precise decision-making (a deeper understanding rather than simply execution of a checklist or other simple procedure). Those are wholly in the wheelhouse of AEPs and the Navy needs our expertise to adequately develop the spectrum of strategies, tactics, and tools to pull this off!

CDR Jim Patrey, AEP #110, reports for his final day of active duty to Naval Air Warfare Center, Aircraft Division in Pawtuxent River, Maryland.

Do you have any advice for young officers looking to make a career of the Navy?

Remember the mission of AEPs, learn all you can about how the fleet operates until you understand how you can help them, be the CAPT of your career and life (borrowed from CAPT (ret.) Schmorrow via CAPT (ret.) Dennis McBride), and remember that the next thing that needs doing doesn't have a blueprint to achieve it – adapt and overcome! And enjoy the ride – your career will span only a small number of tours.

What are your plans for the future? Will we be seeing proposals come through our research programs with Dr. James Patrey as the author?

I've already gotten to spend a good amount of time with family, not only at home, but visiting kids in Ireland, Switzerland, and South Africa, have visited by parents and brothers several times, and have plans to visit kids in Tennessee, Hawaii, and Ireland over the coming months (I only have 4 kids, but they're very mobile!) as well as in-laws in Illinois. That remains a priority for me. I recently joined Team Rubicon and deployed to the recovery efforts in North Carolina from Hurricane Florence, helping out a bunch of families (most retired USMC) recover from losing most all of their possessions from the flooding there. I expect to head back down there again soon and probably to Florida for Hurricane Michael recovery as well. And I still do prison ministry a few times a month and am dabbling with a few other assorted "hobbies." While I am growing my FEMA credentials for disaster relief and may someday get a pay check, most of these activities are volunteer work so don't be surprised if something pops up with my name on it – have to find some money to support my habit! (although don't plan to be doing that full-time again) – as I haven't lost my love for our community nor psychological research.

CDR Jim Patrey (right), AEP #110 along with CAPT(ret) Dylan Schmorrow (center), AEP #104, and CAPT Joseph Cohn (left), AEP #113 arrive in Honduras, flying with squadron VR-1, circa 2007.

Joint meeting with members of both the Navy Research Psychology and Aerospace Experimental Psychology communities, circa 2008. CDR Jim Patrey is pictured in the back row, sixth from the right.

CDR Jim Patrey with his wife, Catie. Fair winds and following seas on your retirement from the US Navy!

BRAVO ZULU

SOME NOTABLE ACCOMPLISHMENTS FROM OUR SHIPMATES IN THE AEP COMMUNITY

LCDR Dave Rozovski (above right), AEP #147, was officially promoted to Lieutenant Commander (O-4) in the Fall 2018. LCDR Rozovski is a dual-designated AEP and H-60 helicopter pilot, currently serving aboard the USS Harry S. Truman, CVN-75.

CDR Hank Phillips, AEP #119 (pictured above left) has been named Acting XO for Naval Air Warfare Center, Training Systems Division (NAWCTSD) and Naval Support Activity Orlando for a 9 month period from Nov 2018 - Jul 2019. NAWCTSD is an Echelon 4 major shore command with a staff of 1600 and obligation authority of $1.6B/FY.

LCDR Dave Rozovski (above left), AEP #147 successfully completed all flight training requirements and was officially winged as a Naval Aviator in September 2018. LCDR Rozovski shared the opportunity to fly some of his colleagues visiting the Jacksonville, Florida area. Pictured above left to right are CDR Hank Phillips, AEP #119, LT Joe Mercado, AEP #152, and CDR Chris Foster, AEP #125.

CDR Deborah White, AEP #117, was awarded with the 2018 NAVSEA Warfare Center's Innovation Team Award for her role as Fleet Liaison role as part of the Virginia Payload Virtual Reality Team. The award was given for application of innovative principles in the development of a proof of concept Virtual Reality training capability for the new Virginia Payload Tube, improving existing capabilities and Fleet training efficiencies at reduced cost.

CDR Tatana Olson, AEP #126, was presented with the CAPT Michael G. Lilienthal Leadership award. This is awarded in recognition of an individual who has significantly advanced the field of Aerospace Experimental Psychology through excellence in leadership over the past year. Award recipients have consistently demonstrated their ability to: motivate and inspire others; apply foresight and resourcefulness in anticipating and overcoming significant challenges; and maintain strength of character in the face of adversity.

LT Mike Natali, AEP #150, was awarded the the CDR Robert S. Kennedy Award for Excellence in Aviation Research. This is awarded in recognition of an individual who has made significant and outstanding contributions to the field of aerospace psychology through original research over the past year. Award recipients have consistently demonstrated their ability to apply their scientific acumen to solving research challenges of critical importance to the Naval Aviation community. The results of their research have directly contributed to demonstrably more effective Selection, Training, Safety and Human Performance technologies in the service of Naval Aviation.

CAPT(ret) Frank Petho, AEP #64, was awarded the CAPT Paul R. Chatelier Award for Lifetime Achievement, which honors individuals who have significantly and uniquely shaped the field of Aerospace Experimental Psychology through scientific, analytic, managerial and leadership excellence over the course of their career. Award recipients have demonstrated a broadness of vision combined with force of character to achieve long ranging goals that have often run counter to common wisdom. The results of their dedication, persistence and foresight have led to paradigm shifting accomplishments that enable the Naval Aviation community to rapidly and effectively overcome current and emerging challenges and threats.

LT Claire Modica, (above left) accompanied by SGT Nicholas Harris, led the Motorcycle Safety portion of the Walter Reed Army Institute of Research and Naval Medical Research Center's 101 Days of Summer Safety Stand Down.

LT Eric Vorm (above left), AEP #149, successfully defended his PhD dissertation titled "Into the Black Box: Designing for Transparent Artificial Intelligence" on December 13th, 2018 at Indiana University. LT Vorm, a former enlisted Corpsman who joined the AEP community in 2012, was given a unique opportunity to complete his PhD on active duty through the Navy Duty Under Instruction (DUINS) program. LT Vorm will soon report to the Navy Center for Applied Research in Artificial Intelligence at the Naval Research Laboratory in Washington, DC where he will apply his new skills towards solving some of the DoD's most challenging problems in Artificial Intelligence.

LT Mike Natali, (above left) AEP #150, is awarded the Navy and Marine Corps Achievement Medal by CAPT Joseph Lavan, Officer in Charge at the Naval Aerospace Medical Institute, for his outstanding work as Vice Chair of the Scientific and Ethical Review Committee.

LT Sarah Sherwood (third from left), successfully completed her flight training and was winged as AEP #160 on February 8th, 2019 at the National Naval Aviation Museum in Pensacola, Florida. She is joined here by fellow AEPs LT Heidi Kaiser, AEP #159; LT Mike Natal, AEP #150; LCDR Ken King, AEP #158; LCDR Lee Sciarini, AEP #141; and CDR Mike Lowe, AEP #132.

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