Improving Learning After the Accident: VR & Aviation Mishap Education

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ABSTRACT

Safety in military aviation is a high stakes game. Every year, on average, the USAF experiences 9.6 fatalities and 8.8 aircraft destroyed with total damages costing $547 million. While this may sound shocking, the number of fatalities and aircraft lost has been steadily declining since 1952, when there were 1,214 fatalities and 789 aircraft lost in one year. This downward trend continued until 2005, where it has stabilized and remained constant, despite numerous safety initiatives implemented during the past 15 years. This paper proposes that the USAF could lower fatality and destroyed aircraft rates by incorporating Virtual Reality (VR) headsets in the post mishap safety investigation process. Specifically, VR should be utilized to teach aircrew lessons from previous mishaps through the experiential learning method, allowing them to visualize mishap recreations in 3D virtual space. This paper will describe the current post mishap investigation process and analyze flight safety statistics focusing on common human factors. The Experiential Learning (EL) model will be examined, focusing on how VR can take advantage of this approach. Additionally, the paper will overview the characteristics of military flight simulators and what current efforts in VR are yielding for pilot training. Finally, proposals for research will be presented to hopefully to validate these initiatives.

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INTRODUCTION

Safety is a high visibility topic in aviation due to the extreme consequences when things go wrong. A crash can take the lives of hundreds, put airlines out of business, and cost millions of dollars in damages. Military aviation safety has unique challenges because military aircraft are constantly put in flight envelopes that are inherently risky. To mitigate these high-risk activities, each military service has developed robust safety management systems (SMS) which have proven extremely effective. From 1952 to 2004, the number of fatalities and destroyed aircraft per year has declined from 1,214 and 789 to 10 and 9, respectively (*AFSAS Report: Class A Mishaps*, 2021). While this is a tremendous improvement, this downward trend has plateaued from the early 2000s to present day (see Figure 1) remaining relatively constant throughout this period.

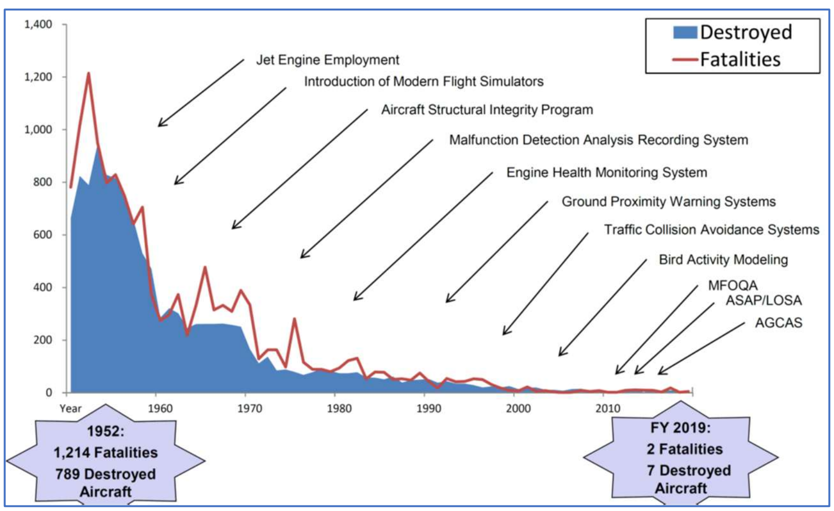

Figure 1. Mishaps from 1952

Between 2010 and 2020, the average annual number of recorded fatalities was 9.6, the number of destroyed aircraft was 8.8, with total damages costing $547million. Furthermore, despite a multitude of creative initiatives over the past 15 years, the Class A mishap rate has remained relatively constant, fluctuating between 1.17 and 1.77, with an average of 1.43 mishaps per year (see Figure 2). Class A mishaps are defined as a mishap costing $2,000,000 or more, a mishap resulting in a fatality or permanent total disability of the operator, the destruction of a DoD aircraft, or the permanent loss of primary mission capability of the aircraft. This paper will explore a new approach to reducing this Class A mishap rate utilizing emerging VR technologies.

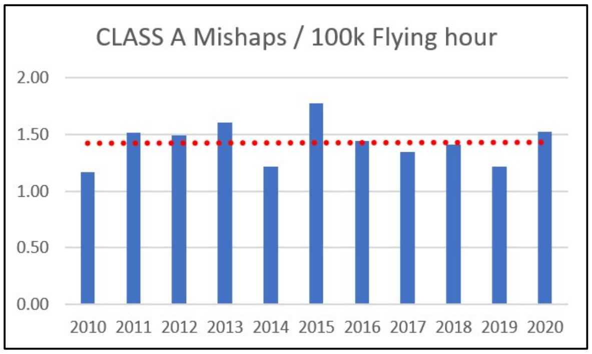

Figure 2. 2010-2020 Mishap Rates

Every safety investigation report includes a list of factors and findings contributing to the event and corrective recommendations to prevent a similar mishap. The conveyance of this information is either written or in vocal presentation format. This paper will propose that disseminating safety investigation reports in this manner can be greatly increased by taking a more experiential learning (EL) approach. The EL approach is now possible to achieve at scale due to the low cost to of VR headsets relative to traditional flight simulators with potentially greater effectivity.

CURRENT PREVENTION MEASURES POST MISHAP

When a Class A mishap occurs in the USAF, usually the Major Command that "owns" the mishap aircraft will be responsible for ordering and overseeing the subsequent Safety Investigation, known as a Convening Authority (CA)("AFI 91-204: Safety Investigations and Hazard Reporting," 2020). The CA will order a Safety Investigation Board (SIB) to be convened. The SIB is comprised of several investigators and experts from various applicable fields, including aircrew, senior maintenance personnel, flight surgeons, representatives from the aircraft manufacturer, air traffic controllers, and legal experts (this list is not exhaustive). The SIB reviews the evidence and interviews witnesses to determine why the event occurred to prevent recurrence. To do this, root cause must be determined, and sound preventative recommendations developed. This is accomplished by first determining what factors led to an event, developing findings from those factors, and finally crafting recommendations ("AFI 91-204: Safety Investigations and Hazard Reporting," 2020).

The investigation culminates with a formal report that contains a narrative sufficient for conveying critical mishap prevention information to the reader. It contains the content of the investigation, the analysis, and the conclusions of the SIB. The document aims to be written such that the reader can clearly understand how the findings and causes were determined, clearly stating the roles of the individuals found causal in the event sequence. However, due to the complexity of mishaps, the message is not always clear or fully understood. Additionally, the report can be hundreds of pages, often losing the attention of the reader. Once accepted by the CA, this report is distributed to Flight Safety Officers (FSO). There are more than 300 active flying Squadrons in the USAF, each having an assigned FSO. The FSO is an aircrew member who is responsible for managing the unit's Safety program, including the dissemination of SIB reports as applicable to the aircrew within their assigned unit. Whether a report is applicable or not is at the discretion of the FSO (although sometimes directed by higher authority), but there is a lot to be learned from mishaps not just from one's aircraft. Often, investigations are briefed that occurred in different airframes or even from aircraft with entirely different roles (fighter aircraft briefed on a tanker mishap, for example).

Recommendations Are Key

The resultant recommendations of the report are the proposed preventive measures to be implemented and the ones the CA approves are tracked to ensure they are employed, assuring accountability. The recommendations are designed to be feasible and offer effective solutions to eliminate identified hazards, or, if the hazard cannot be eliminated, to mitigate the hazard's potential consequences ("AFI 91-204: Safety Investigations and Hazard Reporting," 2020). The recommendations require recognition of the safety system "order of precedence" concept. This states that in order of precedence, recommendations should address aircraft design changes, the addition of safety devices, the addition of warning devices and finally, the implementation of additional training or procedures. For example, to eliminate or mitigate the identified hazard of a pilot's failure to command landing gear extension resulting in a gear-up landing of a training aircraft, one might consider the following:

1 – Aircraft Design: Implement a fixed gear

2 - Incorporate Safety Devices: Implement an auto-extend system

3 - Provide Warning Devices: Implement cockpit warning lights indicating gear up below certain airspeeds and/or altitudes

4 - Develop Training and Procedures: Improve the checklist or its use via instructor and simulator training

This paper recognizes that the use of simulators is not uncommon in recommendations and is not proposing that VR technology should replace any proposed training in a full-motion flight simulator (FFS). While the fidelity of VR headsets, as of writing this in 2021, is likely sufficient to substitute for the visuals in an FFS, without the correct cockpit controls and switches, would likely provide negative training transfer. This has been highlighted by many studies concluding that while simple tasks can be accomplished with 'near' real-world cockpit setups, as the complexity of task increases, realism and fidelity must increase as well (Stewart et al., 2008). To summarize, if the SIB recommends specific simulator training to mitigate a specific hazard associated with a specific aircraft frame, it is outside the scope of this paper to determine whether VR could be substituted for FFS. Instead, this paper will be focusing on opportunities to convey more abstract lessons learned from investigations to the broader aircrew community, not just the community associated with the mishap aircraft.

HUMAN ERROR

Aviation mishap prevention must be addressed via a multifaceted approach, ranging from better maintenance and procurement processes to more effective aircrew training and regulations. While VR could potentially revolutionize each of these approaches in unique ways, contributing to an overall reduction in mishap rate, this paper will focus on improving aircrew training post mishap.

The DoD attempts to codify Human Error through categorization called Human factors (HF). HF describes how humans interact with tools, tasks, working environments, and other people who may influence human performance. HF are the leading cause of DoD mishaps. The DoD Human Factors Analysis and Classification System (HFACS) model presents a systematic, multidimensional approach to error analysis and mishap prevention (DoD, 2020).

Active Vs Latent Failures

Active failures are the actions or inactions of individuals that are believed to cause or contribute to the mishap (Reason, 1990). Traditionally referred to as "error," they are the "last acts" committed by individuals, often with immediate consequences. In contrast, latent failures are pre-existing conditions within an organization which indirectly affect the sequence of mishap events. These latent failures may lie undetected for some period prior to their manifestation as an influence on an individual's actions during a mishap.

Reason's "Swiss Cheese" model describes the four levels within which active failures and latent failures may occur during complex operations (see Figure 3). The holes in the layers represent failed or absent hazard mitigation controls which may contribute to the overall mishap circumstances. Working backward from the mishap, the first level of Reason's model depicts those Acts that most immediately lead to a mishap. Most causal factors are uncovered at this level. Reason's model, however, forces investigators to address the latent failures, or "holes," within the causal sequence of events which may be overlooked if the focus is limited to individual actions only. Latent failures and conditions are described within the context of Reason's model as Preconditions, Supervision, and Organizational Influences.

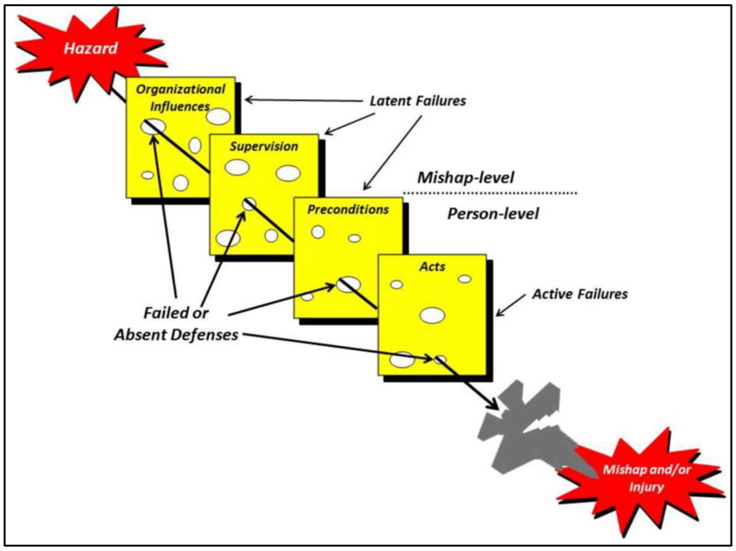

Figure 3. Reason's Swiss Cheese Model

Active Failure Mishap Statistics

For the purposes of this paper, we will focus on mishaps that were primarily caused by aircrew "active failures," with the aspiration that focused VR training may reduce the occurrence of such mishaps. It may be contentious to separate mishaps into two categories, aircrew active failures, and all other latent failures. This is not to say the mishaps that fall into the first category translates to the aircrew being 100% at fault, but it does assume that their actions were either contributory or causal, and that efforts into mitigating these failures will have a net benefit, regardless of who should have the preponderance of "blame." For frame of reference, a 1997 study analyzing aviation mishaps worldwide found that two-thirds of all mishaps were attributed to mistakes made by the crew (Helmreich, 1997).

It was determined after analyzing USAF Class A mishap data from 2010 to 2020 that pilot or aircrew active failures were causal in 44% (94/214) of all mishaps reported (*AFSAS Report: Class A Mishaps*, 2021). We will classify these events as Aircrew Active Failure (AAF) mishaps. If classified as an AAF then it is assumed that some amount of training or preventative measures targeted towards the pilot or aircrew could have prevented the mishap. Between 2010 and 2020, AAF mishaps accounted for 52 fatalities and $3.7 billion in total costs. Analyzing the specific human factors associated with all these mishaps, it was determined that 68% involved "Distraction" and 55% involved "Fixation" (see Figure 4).

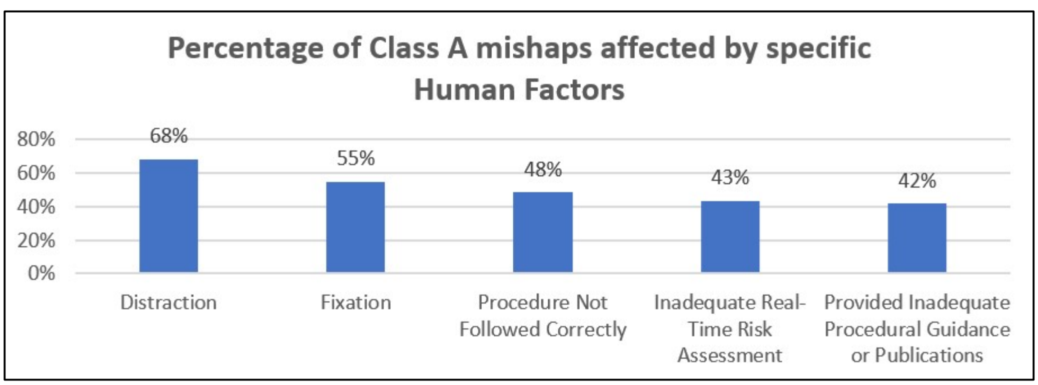

Figure 4. Most Common HF Causal Factors

Distraction And Fixation

Considering more than half of all mishaps are in some way related to the aircrew being distracted or being fixated, this is an excellent place to focus mitigating measures utilizing VR. Most aircrew, if not all, have been briefed on numerous occasions the dangers of becoming fixated or distracted while performing aircrew duties, and how they can directly contribute to a fatal and/or costly mishap. But why does it keep happening? Stepping outside of aviation, distracted driving represents another statistical example of how, despite the best efforts of the National Highway Traffic Safety Administration (NHTSA) to educate the US driving population, a known hazard continues to contribute to fatalities. From 2010 to 2018, distracted driving contributed to 3,275 lives lost per year, on average (USDOT, 2017). The percentage of distracted driving deaths has remained relatively constant since 2010, accounting for 9.5% of all traffic related deaths (see Figure 5). Most people, if not all, know that distracted driving is dangerous, but why hasn't this percentage decreased?

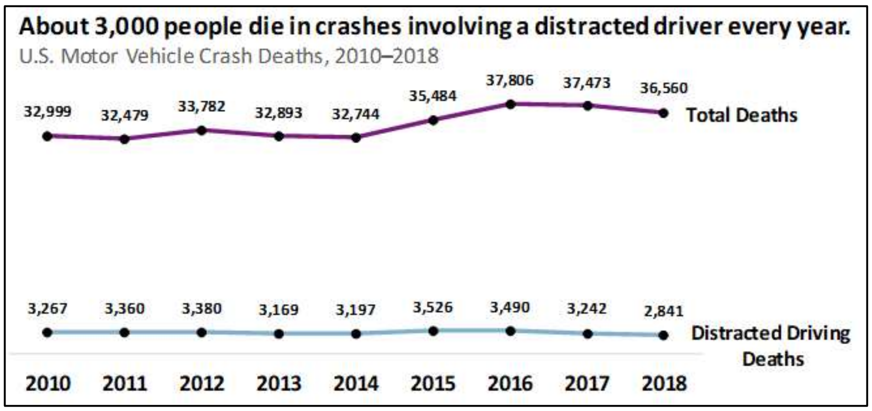

Figure 5. Distracted Driving

Enter the hot stove analogy. People from around the world can relate to this analogy. A parent warns a child not to touch a hot stove, or else they will burn their hand. Despite the parent's best efforts, the child inevitably touches the stove (inadvertently or otherwise) and learns the valuable lesson from experiencing it firsthand. Going forward, the child is keenly aware that hot stoves cause pain and are dangerous. Only through experiential learning is this lesson truly learned.

The analogy, when applied to our AAF mishaps, goes like this: aircrew are briefed that being distracted or becoming fixated in the cockpit can be deadly and dangerous. Until a pilot has a "close call" in their aircraft due to fixation or distraction, however, he or she will not see the warning signs, despite reading numerous safety reports on the topic. What if we could have the pilot "experience" the exact scenario that has led to the real-world mishap, but with none of the risk? Of course, this is not a novel idea; it is executed in flight simulators when aircrew practice simulated emergency procedures. Yet this is typically only applied to that specific aircraft simulator training syllabus. Additionally, due to the constant high demand for simulator hours to satisfy currency training, the use of simulators to recreate specific mishap sequences is rare. This paper proposes that due to the relatively inexpensive costs associated with VR, the USAF could not only re-create specific mishap sequences without competing for Full Flight Simulator (FFS) time but could also allow for training across aircraft types. We will theorize why this may work by concentrating on the "experience is the best teacher" concept.

THE CASE FOR EXPERIENTIAL LEARNING

Next, we will discuss Kolb's Experiential Learning Theory (ELT) and how we can apply it to our mishap prevention initiative. To summarize it simply, "Learning is the process whereby knowledge is created through the transformation of experience" (Kolb, 1984). The following are some key concepts from ELT that have been built upon by other scholars.

Experiential learning – learning using the students real-world experiences to build new knowledge, based on what they already know so they can make new connections and gain new knowledge (Beckem & Watkins, 2012).

Experiential Learning Theory - a holistic and adaptive process within adult learning where experimentation, cognition, and behavior are essential elements of the learning model (Mccarthy, 2010). ELT focuses on trainees bringing their own experiences into the learning environment (Difrancesco, 2011). Relating it to our mishap prevention initiative, for the aircrew to effectively learn about the presented mishap, they must be able to relate it to their previous aviation experience. They need this base to build upon, and without it, the exercise is simply a person in VR watching a mishap for entertainment.

The EL process has four stages that the student will engage in while learning (Kolb, 1984) (see Figure 6):

1. Concrete experiences
2. Reflective observation
3. Abstract conceptualization
4. Active experimentation

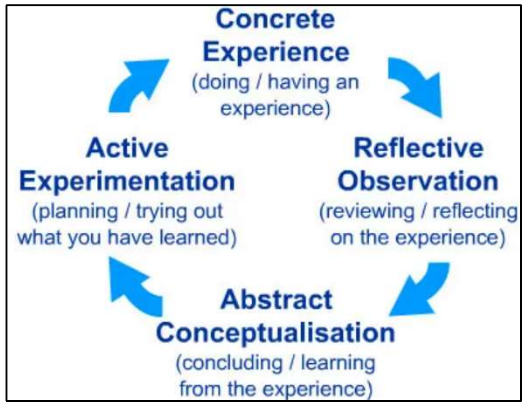

Figure 6. The Experiential Learning Cycle

Concrete experiences (experimenting) - learning comes from experience. This includes experiencing the concrete, tangible, and authentic qualities of the world. Learning takes place when a person combines these experiences with their own senses and immersing themselves into a real-world situation (Mccarthy, 2010). This requires our VR recreation to be relatively convincing to engage the trainee's senses and heighten the sense of immersion.

Reflective observation (observing) - the ability for students to reflect on scenarios and situations. Within the virtual world, this reflective process is just as important. There are three types of reflection used by students: content reflection, process reflection, and premise reflection (Difrancesco, 2011). Content reflection is when students encounter an event and think about the event. Next, the learner moves to process reflection, where learners move into the problem-solving process. The process reflection supports social or situated learning. Third, learners apply premise reflection, which requires learners to examine their own beliefs, values and assumptions (Difrancesco, 2011). In our scenario, the student would reflect on what the mishap event was, why did it happen, and finally, would it happen to them, based on their background and experience?

Abstract conceptualization (reviewing) – the student learns from perceiving new information through symbolic thinking. Students may not always experience a concrete activity, but may observe a phenomenon that is abstract, such as a theory found in science, math, or another academic subject. These abstract phenomena provide a symbolic experience of an action, such as cause and effect, or the influence on something or somebody. In our scenario, the student would notice not that the mishap pilot in the recreation is performing a procedure incorrectly, but that their whole approach or mindset is incorrect, and the student will hopefully internalize this.

Active experimentation (action planning) - One of the key concepts behind the four stages of EL is the ability for the student to actively experiment and then reflect on what occurred. EL creates the highest level of understanding, context, and retention of student learning (Kolb, 1984). In our scenario, this is the student experimenting with their recovery from the mishap. The pilot applies their idea to the virtual environment to see what happens. In aviation terms, this might be akin to getting a "feel for the aircraft" by inducing several turns, climbs or descents.

Activities that focus on taking advantage of EL are called experiential exercises. Two advantages of using these exercises are the ability to provide timely feedback to the student, and the ability to be highly engaging (Devasagayam et al., 2012). Experiential exercises that are rigorous, demanding, engaging, and involve learners are an invaluable tool in achieving objectives related to decision-making in a real-life environment (Devasagayam et al., 2012). In addition, these exercises allow the learner to make choices, reinforce knowledge, and encourage students to use critical thinking skills to solve problems (Devasagayam et al., 2012).

How to Engage EL in VR

For VR to teach a user through experiential learning, the VR must be realistic and convincing. If done correctly, it can enact profound and lasting changes in the student's behavior. This makes VR similar to real world experiences, which is a major qualitative difference between it and watching a video (Bailenson, 2018). The benchmark on whether the VR is realistic and convincing enough is measured on two factors: presence and immersion. Presence can be seen as the sensation of 'being there' in the virtual environment (M. Slater, 1999). Where presence describes the subjective feeling, immersion is the objective characteristic of the technology, referring to the extent to which the computer displays are capable of delivering an inclusive, extensive surrounding and vivid illusion of reality to the senses of a human participant (Mel Slater & Wilbur, 1997).

The primary causal human factors we would like to decrease are Fixation and Distraction, as previously noted. A relevant, classic example shown to student pilots is that of Flight 401 in 1972 (NTSB, 1973). Before landing, the aircraft indicated that not all the wheels of the landing gear were in the down and locked position. The crew began troubleshooting and became so fixated on the problem, they did not notice that the autopilot had disengaged. They were so distracted that they did not notice the aircraft began a gradual descent. The aircraft impacted the ground killing 96 of 163 passengers and the entire crew. The post-accident investigation revealed that one of the bulbs on the gear indicator was burned out, and their gear had been locked down correctly.

Admittedly, this is a very impactful story. It does not, however, have the same "hot stove" effect or "concrete experience" as we have outlined above. Now imagine the scenario is recreated but the student is wearing a VR headset and feels like he or she is in the cockpit of Flight 401. Without telling them about the mishap beforehand, you carefully distract them through various methods like radio calls, warning lights, crew discussions, until they either notice the altitude loss and verbalize they would take corrective action, or they experience the crash. The immersion and presence would need to be high, but with current technology it would be possible to accomplish.

TRADITIONAL FLIGHT SIMULATOR COSTS VS VR

Simulators are designed based on the type of capabilities to be improved or developed. They provide the learner a targeted opportunity to practice a certain type of procedure, skill, or behavior. In simulators, the learner is provided with a safe, repeatable environment and context to gain immediate feedback on the execution of the desired skill or behavior and develop fluidity in action (Clayton & Straub, 2020).

Historically, the USAF's simulator technology adoption was constrained by expensive initial and recurring sustainment costs that ultimately limited total availability (Durose, 1982). Despite these constraints, the USAF has depended upon simulators for decades to reduce costs, extend aircraft life, maintain flying proficiency, and provide more effective training, especially in areas difficult to train in operational aircraft (Dunlap & Carretta, 1998). Table 1 outlines the graduated costs associated with the various simulators available (Slade, 2021). Most military simulators fall into the FAA Qualified FFS category.

Table 1. Simulator Costs

Single screen, table mounted, with yoke and rudder peals	\$1,000 - \$5,000
Multiple screens, up to 180° FOV, with instrument panel, and full controls	\$10,000 - \$50,000
Entry level enclosed flight deck with motion	\$50,000 - \$100,000
FAA qualified level 6&7 Flight Training Device (no motion)	Up to \$1,000,000
FAA Qualified FFS (full motion)	\$10,000,000 - \$50,000,000

With the proliferation of VR in 2015 and the technology becoming "mainstream," a paradigm shift has taken place. The quality of VR headsets has increased precipitously, and the corresponding cost has reduced sharply. As of 2021, a VR headset with visuals compared to military flight simulators range in cost between \$250 - \$800, and a high-performance PC capable of running the VR headset can be obtained for roughly \$2,000. These two factors have captured military leaders' attention and spurred several programs that have sought to innovate previously stagnant training programs.

One that highlights this trend is the USAF's Undergraduate Pilot Training Next (PTN) program. While still a nascent program, initial results are extremely promising. The program aimed to reduce both the length of training time and cost per student while maintaining the same quality of output. The program is designed to accommodate both Mobility Air Force (MAF) students, who go on to fly cargo, tanker, and ISR aircraft, as well as Combat Air Force (CAF) students, who go on to fly fighter and bomber aircraft. Traditional Undergraduate Pilot Training (UPT) requires 117 T-6 Texan II flight hours compared to the new PTN's T-6 flying program of only 65 hours. This implies that if instructors and other support functions are available, PTN could leverage the current UPT T-6 utilization rate and flying hour program projections and increase pilot production by 44% (Pope, 2019). As shown in the Pope's cost analysis report, PTN's MAF fixed costs equate to less than half of UPT's, while PTN's CAF is nearly a quarter of UPT's CAF cost. Similarly, PTN's variable costs are a third and a tenth (MAF and CAF, respectively) of UPTs costs (see table 2).

Table 2: Cost Comparison Between UPT and PTN by Cost Type

Cost Investigation	UPT	PTN
Initial Cost: MAF Track, Per Student	$ -	$ 656,423
Initial Cost: CAF Track, Per Student	$ -	$ 648,888
Fixed Cost: MAF Track, Per Graduate	$ 759,038	$ 339,603
Fixed Cost: CAF Track, Per Graduate	$ 1,138,144	$ 332,068
Variable Cost: MAF Track, No Support Cost, Per Graduate	$ 220,038	$ 70,025
Variable Cost: CAF Track, No Support Cost, Per Graduate	$ 432,296	$ 62,491

The initial empirical evidence is still not substantial, but subjective evidence gathered by interviewing PTN instructor pilots was positive. All instructors interviewed agreed that PTN graduates were at least as good as, if not better than, many of the instructor's previous pupils taught using legacy USAF pilot training methods (Pope, 2019).

PROPOSED TESTS

Further research is required to either validate or invalidate whether VR in the post mishap process would be worth the investment. While there are a range of experiments that could be evaluated, both with the type of VR headset and peripherals (controls, haptic inputs, etc.), and desired learning objectives, this paper will propose a simplistic trial.

- A base with an operational MAF flying squadron will be selected.
- A fictional mishap created, drawing inspiration from one or many real-world mishaps, where "distraction" and "fixation" are listed as the primary causal factors.
- A control group will be briefed on the fictional SIB mishap report. At the same time, the test group will be presented the same report findings, but in addition they will experience a virtual recreation of the event utilizing VR headsets. This recreation will be tailored to emphasize the findings that came out of the report.
- The headset and software will be the same as the current setup used in PTN emulating a T-1 MAF trainer aircraft.
- Two weeks later, both groups will be asked to participate in a simulator sortie in their aircraft's on-base FFS. Events similar, but not identical, to the mishap will be introduced, and the crews will be asked to maintain certain parameters like airspeed and altitude while they deal with various injects.
- Finally, an insidious emergency will be introduced, and their ability to maintain control of the aircraft and situation will be recorded and scored by an impartial panel of instructors.
- The results of the two groups will then be compared and if there are favorable results for the VR group, then the test will be expanded to CAF and helicopter test groups to continue to validate the results.
- Further research could include "cross-community" testing, where a CAF pilot is instructed on a MAF mishap, but tested in his or her own aircraft FFS, to ascertain if the experiential learning could be applied across aircraft types.

EFFECTIVENESS, BENEFITS AND LONG-TERM VALIDATION

There are ample studies that show supplemental flight simulator training to be highly effective. A metanalysis examining 247 articles, research reports, and technical reports containing 26 unique experiments, concluded that the use of flight simulators combined with aircraft training consistently produced improvements in training compared to aircraft training only (Hays et al., 1992).

Additionally, the use of motion cueing adds little to the training environments and training outcomes appear to be influenced considerably by the type of task and the amount and type of training given (Davison, 2018). It also appears that having an effective training strategy is more important than the overall fidelity of the simulator. When advantages of the simulator versus the aircraft are exploited (e.g., successive iterations of a task until it is mastered), training in the simulator plus the aircraft is shown to be superior to training in the aircraft alone (Stewart et al., 2008).

One study that is particularly germane concluded that aviation safety briefings given to passengers via VR headsets in comparison to traditional verbal safety briefings were far superior (Chittaro & Buttussi, 2015). Both groups of passengers were tested immediately after the initial presentation, as well as one week later. In both cases, the passengers who received the VR briefing were shown to be more engaged, retained the information better (both short term and 1 week later), and when asked to perform the emergency procedures, they performed them to a higher competency. The study found that the retention of skills taught in a virtual reality environment were based primarily on equipment fidelity, realism, and integration of available technology. Engagement was far higher as well due to the mild fear the passengers experienced (i.e., hot stove analogy / EL method).

Another study found a positive correlation between a student’s interest in a specific technology with their ultimate retention of skills taught using that technology (Wong et al., 2017). It is presumed that most pilots receiving the VR mishap recreations would have an interest in VR, at least more so than in verbal or written report format, and therefore would have a much higher receptivity to internalizing the findings of the report.

Another aspect that would aid in the receptivity of the report and the overall cognitive understanding of what actually occurred in the mishap would be the recreation of the flight paths in a 3D environment. Reports that require recreating the mishap sequence in 3D, especially relevant in mishaps that involve multiple aircraft, often struggle to clearly convey the situation through the written report. Typically, 3D animation video files are attached to the report, but when viewed on a fixed view, 2D screen or projector, spatial orientation is often hard to achieve, as the literature suggests (St. John et al., 2001). While this technology is still being tested and developed, a recent report showed positive aspects of mission planning, briefing and debriefing in a 3D space utilizing VR (Alexander et al., 2019).

CONCLUSION

The utilization of VR has shown great promise for military aviation, as demonstrated in past studies as well as current programs such as PTN. These success stories hinge on the experiential learning model as applied in andragogy. The proposed research put forth by this paper seeks to educate aviators on past mishaps, in hopes that they “learn by doing,” or to use our previous analogy, they experience the “hot stove” in a virtual environment, instead of in an actual aircraft. These trials will hopefully result in conclusive evidence that mishap findings are better internalized utilizing VR than the current traditional information distribution.

The real evidence that would show if this new initiative is worth continuing, however, would be an actual lowering of the Class A mishap rate. A second indicator would be the reduction of mishaps with causal or contributory factors being “fixation” and “distraction” Human Factors, especially if targeted in the VR scenario.

While the validity of these proposed initiatives must still be proven, a quick cost comparison is worth mentioning. If we assume a VR headset and PC costs roughly $2,000 and we distribute 4 bundles to each of the 300 flying Squadrons across the world, the cost would be $2,400,000. The average cost of a single mishap between 2010-2020 was $17,673,000, which does not even consider the loss of human life. While this estimated cost of the initial VR setup does not take into consideration hardware and software upgrades, or maintenance costs, these could be minimized by simply duplicating the configurations the PTN program has already successfully operated, and the possibility of using the same contracts as PTN would further reduce costs. More research needs to be conducted by the Safety Center at Kirtland AFB, New Mexico, but we are on the verge of an inflection point when it comes to education. The USAF will benefit greatly by being early adopters of the technology, which PTN is already proving. To use a phrase coined by Stanford Professor Dr. Jeremy Bailenson, VR enables users to access "experience on demand." Why would we not allow our aviators to access the experience of previous mishaps to prevent future ones?

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