



The Importance of the **Human Element**

THOMAS R. CHIDESTER AND CARLA A. HACKWORTH

We have all experienced moments where we are left scratching our heads trying to figure out “what just happened?” Have you ever been distracted while taxiing? Have you ever planned your flight, checked weather, and yet inadvertently encountered IMC? Have you ever read back a clearance incorrectly? If so, you have likely thought about what happened and how you can prevent it from happening in the future. That means, whether you realized it or not, you were thinking about human factors and aviation, the very theme of this issue.

What Does “Human Factors” Mean?

The events described above may or may not have human limitation as a root cause, but most require addressing human factors to prevent similar occurrences.

The discipline of human factors addresses how people interact with technology, co-workers, machines, and the work environment to safely accomplish tasks. FAA focuses its human factors research on how pilots, controllers, dispatchers, AMTs, flight attendants, and ground personnel safely and effectively do their jobs. For example, FAA works with designers when new systems are planned and implemented to help do three things:

1. Facilitate appropriate use
2. Prevent mistakes
3. Watch for unintended consequences.

When errors do occur, FAA human factors experts try to understand the factors that led to those errors. One important goal is to determine whether a given error is a one-time problem or a potential pitfall for other people.

Here are some topics and examples of how FAA human factors researchers work to help you avoid many of the common human errors made by pilots.

It Could Have Been Me...

Researchers designed a flight simulator exercise that asks the pilot to plan a trip from Amarillo to Albuquerque. The pilot prepares by reviewing aviation weather online, and then calls Flight Service for a briefing. There are visual meteorological conditions (VMC) at both airports. Clouds are moving across the planned route of flight at various altitudes, but ceilings and visibility are acceptable for flight under visual flight rules (VFR).

The pilot departs for Albuquerque as planned. Flight Watch reports that en route conditions are mostly as forecast. Still, it becomes clear that rising terrain and a decreasing ceiling while approaching the mountains east of Albuquerque will squeeze the flight from below and above. Descending to stay below clouds puts the pilot uncomfortably close to terrain, so he decides to divert to another airport. Executing a turn while tuning and identifying a navaid, he inadvertently enters instrument meteorological conditions (IMC). The aircraft impacts terrain as he exits the cloud.

What was the point of the exercise? The researchers were checking the effectiveness of weather training products. They exposed pilots to different types of training and then put them into challenging situations like the one described above to examine how they prepared and then how they performed when weather deteriorated. Everyone walked away with lessons learned. Unfortunately, many GA accidents have followed a similar path, but without a second chance for pilots to learn from their mistakes. How would you improve your preparedness or performance in this scenario?

The Benefits of Experience

We have all read accident reports where serious risk that is clearly apparent in retrospect went unnoticed by the pilot. Research provides one possible explanation for this behavior: We are more likely to accept multiple risks if we encounter them in a series, instead of all at once. Consider this example. Of course, you would not plan to take a VFR-only airplane into a high-altitude airport when

visibility is deteriorating. But would you recognize yourself in that scenario if you had just lost a navigation radio en route to that airport and found yourself in marginal visibility?

In another example, human factors researchers developed a simulator study involving pilots of varying experience levels, with an equal number of instrument-rated and VFR-only pilots.

The results are surprising. Although you might predict that experienced pilots would be more

willing to forge ahead, the study actually found that more experienced pilots were more skeptical, less willing to fly the planned route under VFR, and more likely to divert and to maintain weather and terrain separation during flight. As stated in the *General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making* (available online at www.faa.gov), "the more doubtful the weather, the more information you need to obtain."

Threat and Error Management

Training for today's airline pilots includes many lessons learned from human factors research. One topic that gets considerable attention is the concept of "threat and error management," or TEM. TEM recognizes that even when flights are planned and operated

by trained and professional pilots in collaboration with dispatchers, mechanics, flight attendants, and others, human beings still make mistakes, especially when the environment presents challenges. The idea behind TEM is to accept this reality and train pilots to recognize errors as quickly as possible and manage, or mitigate, their negative impact.

Seeing Is (Not Always!) Believing

Many human factors specialists focus on the limits of perception. Guidance from research in perception is part of today's pilot training materials. Remember those lessons on visual and vestibular

Research suggests that we are more likely to accept multiple risks if we encounter them in a series, instead of all at once.

Human factors research has contributed to what we know about the impact of workload on pilots.

(motion-sensing) illusions, differences in apparent glidepath as a function of runway dimensions, concerns about differences in color vision and visual acuity, and likely mistakes when flying in night or low visibility? Visual illusions still present great risks, so you may want to review some of the information available in FAA's brochure on this topic: www.faa.gov/pilots/safety/pilotsafetybrochures/media/SpatialD_Seeing.pdf.

Decision Making

Most theories of human decision-making assume a deliberative process: We gather information, consider alternatives, and select

One study found that more experienced pilots were more skeptical and more likely to divert and to maintain weather and terrain separation during flight.

options that maximize benefit and minimize risk. Yet, researchers have observed that experienced pilots don't appear to do much deliberation. Instead, they use what one researcher calls "recognition-primed decisions." This means that pilots who think they understand a situation may believe the solution is obvious. The problem is things can go wrong if "recognition-primed decisions" lead to incorrect or inappropriate responses.

Here's an example. During the past two years, scientists have interviewed and analyzed the details of adverse weather encounters within a group of 25 pilots. They learned that the majority of these pilots did not understand or recognize the danger that the adverse weather would cause. The situations they encountered simply did not appear very different from other marginal situations they had successfully flown through before. The human factors lesson is

this: Be wary. Always question your assumptions and strive for the key elements of good decision making. These include good information, knowledge to understand that information, and experience.

Workload

Human factors research has contributed to what we know about the impact of workload on pilots. As any pilot knows, many things can happen during very brief periods of each flight that can increase the likelihood of error. In too many accidents and incidents, the pilots get "behind" the aircraft, become controlled by changing circumstances, or rush to comply with conflicting duties.

Research has taught us that human beings are limited as information processors. When overloaded, we tend to shed duties and accept a less planned or controlled approach to what we do. These "normal" reactions can create unacceptable, but unrecognized, risk in flight. Human factors research in this area has therefore stimulated development of workload-reducing tools and systems for the cockpit to help keep pilots planning and thinking "ahead" of the aircraft.

Pros and Cons of Technology

Advances in technology can bring unintended consequences. In 2004, researchers found that pilots with access to higher-resolution NEXRAD weather images were more likely to try navigating between areas of heavy precipitation in a simulation study. This response was not the intended use of the system, which was designed to help pilots give significant weather a wide berth. In 2008, another researcher demonstrated that a very brief training program could prevent most pilots from making this mistake.

These are just a few of many examples of how human factors—how you—can have a very real impact on safety. As human factors researchers, our goal is to improve the aircraft you operate, the training you receive, the equipment and support you are provided, and the environment in which you operate. To learn more about research at CAMI, visit: www.faa.gov/library/reports/medical/oamtechreports/. 

Thomas R. Chidester, Ph.D., is Manager, Human Factors Research Division at FAA's Civil Aerospace Medical Institute. Prior to joining FAA in 2007, Dr. Chidester was with NASA as Director, Aviation Performance Measuring System and previously was Manager, Human Factors and Safety Training, American Airlines.

Carla A. Hackworth, Ph.D., is Manager, Flight Deck Human Factors Research Branch at FAA's Civil Aerospace Medical Institute. She has led assessments of organizational effectiveness, GA testing issues, weather-related GA incidents, and human factors in aviation maintenance.

For More Information

FAA Aerospace Medical and Human Factors Research Web Site

www.faa.gov/data_research/research/med_humanfac/

The Effects of NEXRAD Graphical Data Resolution and Direct Weather Viewing on Pilots' Judgments of Weather Severity and Their Willingness to Continue a Flight

www.faa.gov/library/reports/medical/oamtechreports/2000s/media/0405.pdf

General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making

www.faa.gov/pilots/safety/media/ga_weather_decision_making.pdf



Subscribe Today!

FAA Aviation News is available as an annual subscription from the Government Printing Office. There are three ways to sign up today!

- By Internet at:
<http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=750-002-00000-5>
- By contacting GPO toll free at:
1-866-512-1800
- By using the order form in the center of this magazine.

