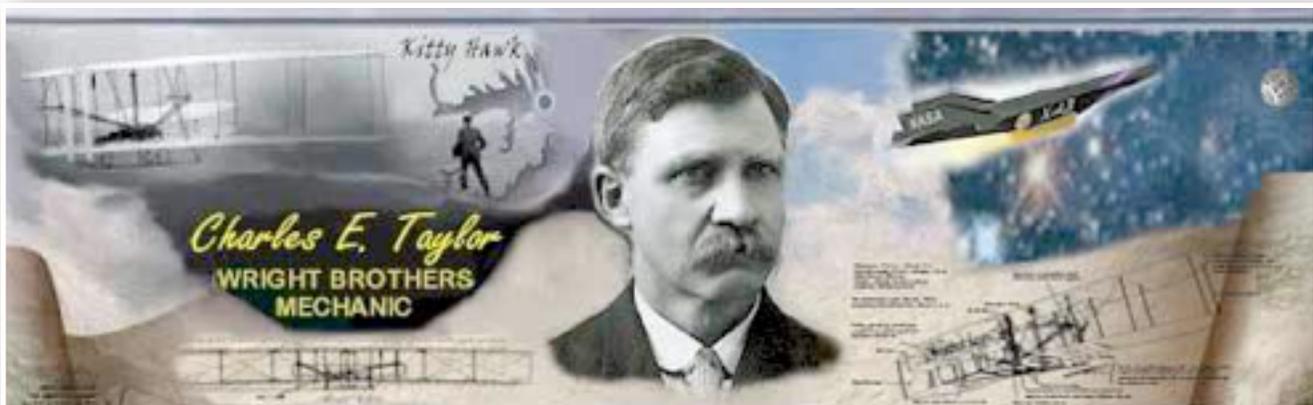


Aviation Human Factors Industry News

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From the sands of Kitty Hawk, the tradition lives on.

Hello all,

To subscribe send an email to: rhughes@humanfactorsedu.com

In this weeks edition of *Aviation Human Factors Industry News* you will read the following stories:

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Report: Cable error caused fatal airplane crash in Spokane River

Cables controlling banking and turning were **improperly installed** on a propeller airplane that crashed into the Spokane River during a test flight in May 2015, according to a final report issued by the National Transportation Safety Board.



The report faults the mechanic in charge of installing the cables, as well as the pilot of the plane, **for failing to notice the error** before the Piper Malibu single-propeller took off just before 4 p.m. from Felts Field. The cable mistake would not have presented any **“obvious visual cues,”** according to Elliott Simpson, the NTSB’s chief investigator on the crash, but **should have been caught** following weeks of maintenance on the plane and in instrument tests that took place moments before the flight. Pilot Richard Runyon, 64, and passenger Lyndon Amestoy, 60, died in the crash, the second that occurred in Spokane in a three-month period in 2015. The report, published in September, does not name the mechanic in charge of maintenance on the aircraft.

Runyon and Amestoy, employees of the firm Rocket Engineering, **were working with urgency that afternoon.** The owner of the airplane was on his way to Spokane from Las Vegas to pick up the aircraft after several delays, and Runyon wasn’t scheduled to work the following day, a Friday, because of an appointment with a Federal Aviation Administration medical examiner.

“It is likely that the mechanic and pilot **felt some pressure to be finished that day** so the owner could depart in the morning and the pilot could attend his appointment,” wrote Simpson, the inspector.

The flight lasted just 11 minutes and the plane experienced a sharp right roll immediately after takeoff, according to reports. Runyon corrected the error and attempted to return the plane to Felts Field, but crashed into the river on an attempt to land, according to the report.

Simpson's report notes the plane's maintenance manual [includes a warning in all caps to check what are called the aileron cables](#), which control the plane's banking. The mechanic, who had [22 years of experience](#) in aircraft maintenance, told inspectors that he instructed a coworker to check his installation of the cables, but that coworker [denied independently inspecting them](#) before the crash.

Friends and family members remembered Runyon and Amestoy as experienced pilots.

"Knowing my husband, he would sacrifice himself," said Runyon's wife, Karen, in a 2015 interview.

Michael Clements, 61, died in crash near the Hamilton Street bridge three months before the one involving Runyon and Amestoy. A final report from the NTSB has not been issued in that crash, but a preliminary investigation showed Clements' aircraft [was filled up with the wrong type of fuel](#). A lawsuit has been filed in that case.

[Read the full report here.](#)

[http://www.spokesman.com/stories/2016/jul/01/lawsuit-attendant-who-refueled-plane-that-crashed-/](http://www.spokesman.com/stories/2016/jul/01/lawsuit-attendant-who-refueled-plane-that-crashed/)

Stunt Man Fatally Injured In Fall From Helicopter

Was Participating In An Abseiling (Rappelling) Race In China

A former SAS hero and James Bond stuntman was fatally injured when he fell 300 feet from a helicopter during an abseil race in China.

Steve Truglia from East London held the record for the fastest 100 meter (300 foot) abseil, which is also known as rappelling. He was 54.

The U.K. newspaper The Daily Mail reports that Truglia and another stuntman were purposely rappelling from the helicopter at the same time. A few hours before the flight, Truglia [reportedly expressed concerns](#) that there might be a problem because of the combined weight of the two rappellers. The race had also been delayed at least once because of adverse weather, according to the Truglia's Facebook page.

Details of the accident have been difficult to obtain, according to a former military colleague.



Among the “Most Wanted,” a focus on the human factors in transportation safety

The National Transportation Safety Board (NTSB) released its “10 Most Wanted List” of desired transportation safety improvements for 2017 and 2018 this week – a list that that will now be proffered [every two years](#) instead of on an annual basis, according to comments made by **Christopher Hart**, the organization’s chairman, during a press conference yesterday.

Hart pointed out that though NTSB cannot require the transportation industry to take action on its “Most Wanted” list – a list the agency has been compiling since 1990 – he dubbed it a

“roadmap” built upon the lessons learned from NTSB crash investigations, representing actions which, if taken, would reduce property damage, prevent injuries, and save lives in all modes of transportation.



And while Hart emphasized that transportation as a whole “has become much safer” in the U.S. is much safer over the now 50 years NTSB has been on the scene, [there’s been slippage](#) in the numbers of late – especially in terms of highway fatalities. “From 2014 to 2015, according to the National Highway Traffic Safety Administration (NHTSA), highway fatalities increased by 7.2%; the largest percentage increase since before the NTSB was founded,” he stressed in his prepared remarks. “Worse yet, early estimates show a 10.4% increase in motor vehicle deaths for the first half of 2016 versus the first half of 2015. Tragically, for the first time since 2008, [more than 35,000 people died](#) on our roads.”

Before this turn for the worse, Hart noted that progress on highway safety “looked good,” with fatalities generally declining for decades.

“This setback is a reminder that safety is not a destination, but a continuing journey, and our efforts to improve safety must never stop,” he explained. “It takes a concerted and continuing effort by industry, government, and private citizens to save lives.”

To that end, here is what NTSB believes are the top 10 “Most Wanted” improvements to transportation that should help reverse this current deadly trend:

- Eliminate Distractions
- Reduce Fatigue-Related Accidents
- Prevent Loss of Control in Flight in General Aviation
- Improve Rail Transit Safety Oversight
- End Alcohol and Other Drug Impairment in Transportation
- Increase Implementation of Collision Avoidance Technologies
- Expand Recorder Use to Enhance Safety
- Require Medical Fitness
- Strengthen Occupant Protection
- Ensure the Safe Shipment of Hazardous Materials

As usual, there's a big emphasis on technology within NTSB's "most Wanted" list, with further use of collision-avoidance technology – especially for motorized vehicles – encouraged.

Yet note the preponderance of "human factor" elements within the "Most Wanted" list for 2017-2018 – especially the focus on medical fitness, fatigue, alcohol/drug impairment, and distraction.

The National Safety Council, for one, thinks this focus is critical as NSC President and CEO **Deborah A.P. Hersman** – herself a former NTSB chair – noted that they are major "proximate causes" and "contributing factors" to thousands of fatalities in transportation annually.

"As 95% of transportation deaths occur on our nation's roadways, if left unchecked, these issues will continue killing thousands of roadway users each year," she explained. "Although our vehicles are safer than ever before, according to NHTSA, human error is responsible for 94% of crashes."

I talked with Hersman last week about the many human factors involved in highway crashes, with her noting that there's rising worry in safety circles about drug impaired driving – especially in light of the push by many states to legalize marijuana, though that is not the only drug of concern.

"Marijuana is of course a huge issue," Hersman told me. "There's a lot of comparison with alcohol [legalization] but it's really not the same. For example, the effects of alcohol have been widely studied; we know the BAC [blood alcohol content] impairment levels for men and women."

Marijuana, however, offers a different challenge as it can be smoked or ingested, with the potency of the marijuana being grown and sold today – in terms of its active ingredient, THC – much greater than the marijuana grown and sold four or five decades ago.

“What constitutes impairment? What constitutes a ‘cut off point’ in marijuana use before operating a motor vehicle?” Hersman asked. “The drug also affects people differently and it packs more of a punch today.”

Then there is the opioid crisis; a far scarier drug problem to Hersman’s mind than the widespread legalization of marijuana, in terms of impaired driving.

“We now know there’s a high risk of abuse; these drugs [opioids] are dangerous because they are prescribed by a doctor so **many think they are OK – that they are safe,**” she said.

In Hersman’s view, a truck driver is far more likely to be at risk of opioid addiction versus marijuana abuse because the truck driver population is older and the nature of the work can lead to injuries.

It just goes to show that technology cannot solve everything, especially when it comes to issues intrinsically wrapped up in **human biology.**

<https://www.youtube.com/watch?v=i0rJOtj1HaY>

<https://youtu.be/i0rJOtj1HaY>

<http://www.nts.gov/>

<http://fleetowner.com/driver-management/even-where-it-s-legal-marijuana-still-drag-truck-drivers>

Complacency in the Cockpit

A human factors expert discusses the subtle dangers facing today's airline pilots.

Tony Kern, who flew B-1Bs for the U.S. Air Force, is the CEO of Convergent Performance, a company that works to reduce human error in high-risk environments such as aviation, military operations, and law enforcement. A former chairman of the Air Force Human Factors Steering Group, Kern has written several books, including *Flight Discipline* and *Darker Shades of Blue: The Rogue Pilot. Air & Space*:



What is the most pressing human factors issue regarding commercial airline pilots?

Kern: There are several human factors issues that need near-term attention, but if you forced me to identify the most pressing of these it is how the industry is handling the largest generational handoff in the history of our industry—or any industry for that matter. Due to several factors—primarily 9/11, the global economic crises, and the age 65 rule—we lost a generation of new hires during the associated furloughs and hiring freeze. The good news from this is that we now have the most experienced pilot force we have ever had—and will ever have in our industry. The bad news is that this experience is rapidly aging out of the industry, and being replaced by talented, but far less experienced aircrew.

Has the increasing digital presence in airline cockpits lead to pilots being unprepared to handle emergencies?

I guess the answer to that question depends on the nature of the emergency. Technology has made our industry much safer, no question about that. But technology can also mask deteriorating situations from the pilot's awareness and cascade a single error into a tragic situation. Hand flying proficiency must be maintained, and I think we need an expanded human factors training program that includes a strong component of automation airmanship. Let's face it, the airline pilot remains the first and last line of defense for safe operations, and data input and verification skills are now as important as knowing how to land in a crosswind.

Far too often, pilots allow automation to make decisions for them, and lose track of what is going on. A classic example of this was American Airlines Flight 965, where [in 1995] the crew crashed into a mountain in Colombia. They were descending, at night, in mountainous terrain, and didn't know where they were. A simple decision to climb back to a safe altitude and figure it out would have saved them, but they had gotten behind the aircraft. A pilot should never let an airplane go somewhere his or her mind hasn't already arrived at a few minutes—or at least a few seconds—earlier.

Are there lessons learned from the training of military pilots that could be useful for airline pilots?

Sure, but this also works in the other direction. Let me give you a couple of examples. I think military pilots do a much better job of briefing and debriefing for lessons learned. On the flip side, I think the airlines do a better job of training to standards. When you think about it, it's amazing that these pilots show up 45 minutes before a flight, meet someone they have never flown with before, and conduct hundreds of thousands of flights every year with nearly zero mishaps. There is a lot of sensitivity in the commercial industry about adopting military lessons. I don't really get this attitude, but it is definitely there.

Forest-fire suppression missions: Is this one of the most demanding and volatile environments a pilot can fly in?

I was the National Aviation Officer for the U.S. Forest Service for five years, and I have to say, I have never seen a group of aviators as dedicated to performing their mission in such a chaotic and high-risk environment. What is even more impressive, is that they do it with technology from the 1950s and '60s. The fire seasons used to last four or five months, but the conditions of the forests in America now dictate a year-round response capability. This puts a real strain on the pilots, maintenance teams, and the entire system. It's time the nation realizes we need to put some serious resources into aerial firefighting if we want to continue to protect our natural resources and the citizens who live in or near them.

What is your opinion of the B-1?

The Bone [a nickname for the B-1] is an incredible jet, the Ferrari of large aircraft. My Bone brothers probably won't admit it, but it's really easy to fly. Tremendously responsive in both power and maneuverability. It's turned out to be the backbone of the bomber fleet and I hope it stays in the inventory for decades to come. It can get to places fast, and deliver devastating firepower upon arrival. No other aircraft in the world can do what it does.

What do you see for aviation's future?

I've been around aviation now for over four decades and am proud that other industries consider us the gold standard for operational effectiveness and safety. But recently, I've sensed we might be resting on our laurels and allowed our great record to speak for itself. We did not get [a stellar safety record] by thinking this way, and we need to do more than study data and correct deficiencies to stay ahead of the curve. We need free thinkers, innovators, operators, maintainers, and regulators to think boldly to drive us to the next level. That is who we are—or at least were—as aviation professionals.

Improving In-flight Communications

The futuristic credentials of [predictive maintenance](#) are often described by the ability of aircraft health monitoring systems to update ground teams of faults before a flight has even touched down.

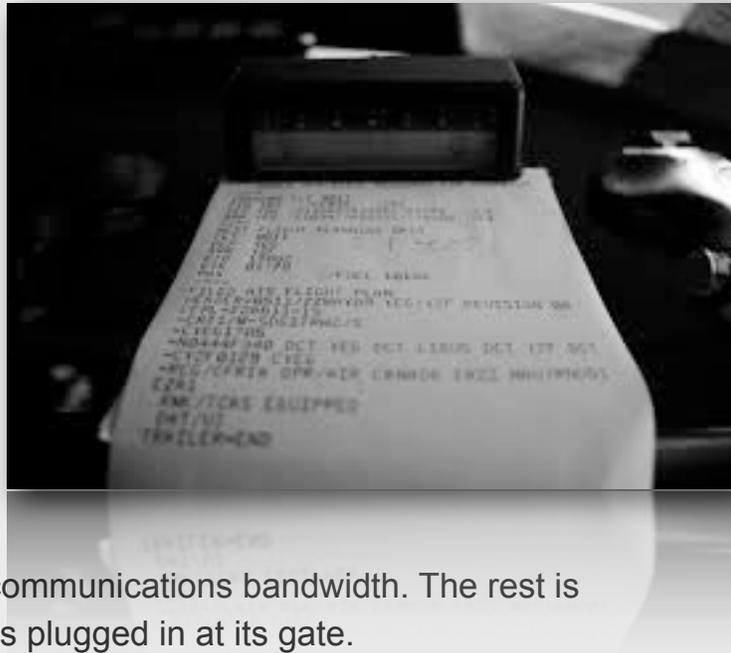
In reality, though, only a tiny fraction of sensor data is relayed this way, as only the most important alerts have access to an aircraft's limited communications bandwidth. The rest is downloaded when the aircraft is plugged in at its gate.

Addressing this imbalance is a priority for engine manufacturers, and GE Aviation has now teamed up with wireless technology specialist Teledyne Controls to boost the capability of the [aircraft communication and recording system \(ACARS\)](#).

Exploiting the higher bandwidth of cellular wireless networks, GE and Teledyne hope to boost in-flight engine data transmissions from a few hundred bytes to several megabytes.

"Applying physics and data science expertise together, on continuous data, is the recipe to create analytics that enable increased detection lead time, reduce maintenance burden and improve asset availability," says John Nelson, data product manager for GE Aviation.

Despite Nelson's predictions, the upgrade – announced at a GE technology event this week – won't make a dent in the roughly 1TB of data that the new-generation engines generate each cycle.



Even so, it's not a meaningless drop in the ocean, as engineers can only react a small portion of data can quickly enough to justify it being sent in real time. GE's uses an in-house-developed platform called Predix to perform its engine data analytics, which fall roughly into two streams: noting trends over time; and spotting exceedances – a spiked reading from a vibration sensor, for instance. It's the latter that in-flight communications are useful for.

Teledyne's data link technology is already installed on half of Boeing and 70% of Airbus aircraft, though improvements to real-time communications [will require upgrades](#) to both ground- and fleet-based infrastructure.

Laser Xmas light displays can pose problems for pilots

FAA: Christmas light display can be dangerous for pilots.

A warning was issued for shoppers getting ready to set up Christmas lights this holiday season. If you have a laser light display or you're thinking of buying one, [be careful where you aim it](#). The Federal Aviation Administration says if they point into the sky, it can be dangerous for pilots. Lisa Wagner owns Mystic Fire Lights where some of these displays are sold.



"They fire about [250 feet](#) on the laser units," Wagner said. "That's not really enough to go up into the air but it will go a short distance."

But the FAA is sending out a reminder to anyone installing the popular displays to make sure the lasers are pointed on only their homes and not into the sky.

In a statement from the FAA, a spokesperson said: "The problems we've experienced were the results of lasers shining above the level of the roof. The [light energy can travel several miles.](#)"

The laser lights are adjustable and can be moved up or down. To make sure they don't shine into the eyes of a pilot, keep those laser lights low enough that they aren't pointed up into the sky.

"Try to be responsible and not shoot it in the air," Wagner said.

As more Christmas laser light displays go up around the city, police and pilots say the growing danger in the sky is [likely to only get worse](#) in the coming weeks.

[New FAA Video Stresses Holiday Drone Safety](#)

If you're one of the lucky people who gets a drone as a holiday present, the Federal Aviation Administration wants you to know how to fly it safely. The agency has released a new video reminding everyone of the rules and regulations that safe drone pilots must follow.



As the video shows, before you fly your drone outdoors, the first thing to do is register it at www.faa.gov/uas. If you're going to operate according to the model aircraft rules, you'll receive one identification number to apply to all your drones. Non-modelers must register each of their drones individually.

The video also stresses that whether you fly your drone for recreation or business, [safety is everybody's responsibility](#). And that means following the rules:

- Don't fly over people and respect the privacy of anyone on the ground.
- Don't fly near other aircraft or in restricted airspace, such as "No Drone Zones."

The video also tells you how to get the FAA's B4UFLY smartphone app that provides the latest information about airspace restrictions wherever you intend to fly your drone. The bottom line: Safe flying is what smart drone pilots do.

[Check out the new holiday video.](#)

Ground, Air Factors Preceded Sabreliner/Skyhawk Midair

An error by local air traffic control and possible limitations to the see-and-avoid concept preceded the Aug. 16, 2015 midair between a Rockwell Sabreliner and a Cessna 172 while in the traffic pattern at San Diego Brown Field, according to the just-released NTSB factual report. The accident killed the one person aboard the Cessna and the four persons in the Sabreliner. Weather at the time of the accident was VMC. The two aircraft collided at about 11 a.m. as the Sabreliner was completing a turn to a right base leg and the Cessna was on an extended right downwind after conducting a touch-and-go. During the time leading up to the collision, the local controller was handling nine aircraft.



Several minutes before the accident, the controller issued a 360-degree turn meant for the Cessna but communicated to the registration number of an aircraft departing the area. When the controller realized the mistake, it was four seconds before the collision and six minutes since any controller had communicated with the Cessna.

The factual report contains a cockpit visual study to examine the ability and limitations of the pilots to see and avoid the other aircraft. It concluded that the aircraft would have been in view of each other at various moments before the collision, [but window posts on both aircraft might have obscured visual observation](#) when the aircraft were 0.1 nm apart. Meanwhile, the Safety Board is holding a hearing on the safety issues, including the see-and-avoid concept, involved in this accident and another 2015 fatal midair. Both a safety recommendation and a Safety Alert will be released following the hearing.

[http://dms.nts.gov/pubdms/search/hitlist.cfm?
docketID=59067&CFID=709908&CFTOKEN=e2c525a43be671c8-E9169939-
ED5A-19CC-C05DAB0DE533FDF5](http://dms.nts.gov/pubdms/search/hitlist.cfm?docketID=59067&CFID=709908&CFTOKEN=e2c525a43be671c8-E9169939-ED5A-19CC-C05DAB0DE533FDF5)

Tips on Broadening Your Flight Department's Safety

Maximizing the effects of 'Positive Safety Performance' in your flight department

Safety generally, and BizAv Flight Department Safety specifically, can wrongly be measured by the lack of harm to people, which implies a negative approach



**Make a Positive
Contribution**

to characterizing a discipline, argues Mario Pierobon. How can you instead broaden your flight department's safety with the effects of 'positive safety performance'? The science and practice of safety has traditionally focussed on counting errors or threats and trying to build better controls around them. Today, this 'pessimistic' (reactive) perspective is increasingly being challenged.

Among those doing the challenging is safety scientist Erik Hollnagel, who argues that safety does not primarily emerge from controlling the things that work poorly in a technical system, process or organization – instead, the focus of the safety science and practice [should be on the things that go well as efforts are made to try and maximize their positive contribution.](#)

This 'optimistic' approach is not very well defined yet in terms of workable solutions for safety professionals to put into place, but it is worth considering the ways **positive safety performance** affects the overall safety in the corporate flight department.

An Endless List

There's probably an endless list of **positive factors contributing** to safe outcomes in the domain of Business Aviation. These include well engineered aircraft; reliable equipment; and well developed training syllabi, etc. Such factors, however, may not universally apply. For example, not every organization has (or can afford) access to sophisticated technical solutions supporting flight safety.

Yet, there are some recurrent patterns that apply commonly throughout the Business Aviation industry, almost irrespective of organization, that **significantly contribute** to positive safety performance.

- **Enthusiasm:** First and foremost, a high degree of enthusiasm in the workforce is required. That comes from a passion for the job, be it a flying or support job. How will a Flight Department Manager achieve the level of enthusiasm among the staff to keep them sharp in terms of safety matters?
- **Creativity:** Flight Departments tend to be relatively small in size and from this, a series of other positive dimensions emerges, including the need to be creative, and for solutions to be found autonomously.
- **Accountability:** Smaller organizations also have strong accountability. Team members know their decisions will directly impact them or their immediate colleagues.
- **Leanness:** Small organizations, like corporate flight departments, also tend to be very lean, dramatically improving the efficiency of decision making and getting straight to the point when discussing safety-related matters.

Business Aviation is essentially a small world. Professionals generally know one another pretty well – and this, at least theoretically – enables an information exchange should issues that impact safety industry-wide emerge.

Growing the Optimistic Approach to Safety

In many ways these dimensions are nearly a 'given' within Business Aviation. Yet while they have not really been 'engineered' top-down in the industry, they survive in spite of financially challenging times.

What an 'optimistic' approach to safety management does require is the reinforcement of good behaviors. For individual organizations it all comes down to [empowering people](#) in the workforce.

These empowerment efforts should be exercised throughout an employee's tenure with the organization.

Employees should be hired if they are perceived to satisfy the soft skill requirements for 'enthusiasm', 'creativity' and 'accountability'.

These skills should be fostered during their time on duty (both during line operations and as a part of their professional development). That may mean adequate focus being placed on those skills during [crew resource management](#) training.

Meanwhile, capitalizing on the 'lean' nature of the Flight Department, managers should provide [immediate feedback](#) to employees when safety issues are raised.

In essence, organizations should always strive to [avoid complacency](#): It is simply not enough to accept the above safety performance enablers are a given; they must be continuously reinforced lest the organization gradually drift into sub-optimal and then poor performance.

In Summary

A positive approach to managing safety needn't replace the more traditional safety efforts – like hazard identification. Yet it should be kept in mind that a Flight Department [could always be doing more](#) to understand why things go well most of the time, and reinforce those best practices.

Aviation professionals should always be looking to broaden their flight department's safety standards. A strong 'Positive Safety Performance' focus to the more traditional preventative measures is a leap in the right direction for any BizAv Flight Department Safety effort.

FAA: Fly Smart this holiday season

Federal Aviation Administration (FAA) Administrator Michael Huerta is encouraging travelers to Fly Smart this holiday season.

“I’m asking air travelers to take an active role in aviation safety when they fly this holiday season,” said FAA Administrator Huerta. “Fly Smart and be prepared. [Your actions can save your life and those around you.](#)”



Flying is incredibly safe. In fact, this is the safest period in aviation history. Government and industry have significantly reduced the risk of accidents by working together on airplane design, maintenance, training, and procedures – but emergencies can happen. “While tens of millions of passengers will rely on air travel this holiday season to connect them to destinations around the world, pilots across the country stand ready. On each and every flight, pilots and crewmembers work together to ensure that the passengers and cargo we carry arrive safely and efficiently to their destinations. Over the next few weeks, airports and aircraft will be a little more crowded, and as always, we encourage passengers [to be patient and listen carefully](#) to crewmember instructions. Aviation is the safest mode of transportation in the world, and passengers have played an important role in maintaining that incredible record by working with crewmembers and complying with federal guidelines,” said Capt. Tim Canoll, Air Line Pilots Association, International President.

“Bring a spirit of community, watch the safety briefing and listen to your Flight Attendants. As aviation’s first responders we are proud to help usher you safely and securely on your travels,” said Sara Nelson, International President of the Association of Flight Attendants.

[Travelers can make their flight even safer by taking a few minutes to follow these guidelines:](#)

- In the unlikely event that you need to evacuate, leave your bags and personal items behind. Your luggage is not worth your life. Passengers are expected to evacuate an airplane within 90 seconds. You do not have time to grab your luggage or personal items. Opening an overhead compartment will delay evacuation and put the lives of everyone around you at risk.

- Pack safe and leave hazardous materials at home. From lithium batteries to aerosol whipped cream, many items can be dangerous when transported by air. Vibrations, static electricity, and temperature and pressure variations can cause hazardous materials to leak, generate toxic fumes, start a fire, or even explode. When in doubt, leave it out.
- Leave your Samsung Galaxy Note7 smartphone at home. You are prohibited from transporting this recalled device on your person, in carry-on baggage, or in checked baggage on flights to, from, or within the United States.
- If you have spare batteries, pack them in your carry-on baggage and use a few measures to keep them from short circuiting: keep the batteries in their original packaging, tape over the electrical connections with any adhesive, non-metallic tape, or place each battery in its own individual plastic bag. You cannot fly with damaged or recalled batteries.
- Prevent in-flight injuries by following your airline's carry-on bag restrictions.
- Use your electronic device only when the crew says it's safe to do so.
- Pay attention to the flight attendants during the safety briefing and read the safety briefing card. It could save your life in an emergency.
- Buckle up. Wear a seatbelt at all times.
 - Protect young children by using a child safety seat or device. Your arms cannot hold onto a child during turbulence or an emergency.

THIS IS HOW LONG IT TAKES BEFORE COFFEE STOPS WORKING

Hate to break it to you, caffeine junkies: Coffee might feel like the Elixir of Life when you're sleep-deprived, but research says that [eventually the magic fades](#), and you really should just hit the sack. A study presented at the 2016 meeting of the Associated Professional Sleep Societies held in Denver found that:

After just three nights of bad sleep, caffeine stopped boosting alertness, performance and mood.

The findings further underscore that “[sleep debt](#) is real,” says Tracy Doty, the research scientist at Walter Reed Army Institute of Research who led the study. “Every night you’re not sleeping, you’re building up increased sleep debt, and the same amount of caffeine is no longer effective.” Earlier studies on the effects of caffeine on performance had typically kept subjects awake all night for multiple nights in a row.



But Doty wanted to mimic a workweek, restricting sleep to five hours a night (less than the recommended seven to nine hours a night) for five nights. Doty’s team recruited 48 healthy adults who slept 10 hours a night for five nights in the lab to ensure they started at the same baseline level. The following week, the researchers restricted their sleep, flipping the lights on after five hours.

Doty’s team randomly assigned the participants to receive caffeine or a placebo — chewing gum with or without 200 milligrams of caffeine ([equivalent to two strong cups of coffee](#)) — twice daily, at 8 a.m. and at noon. From the time they woke up until they went to bed, the participants underwent several rounds of tests that measured their reaction time, mood and sleepiness. “It simulates the workday and even beyond, when you get home and have a million things you have to do,” Doty says.

At first, participants who chewed caffeinated gum [showed significant improvements](#) in their reaction-time performance, and they felt happier. But after three nights of restricted sleep, their performance [slid back to the levels](#) seen in the placebo group. They were also sleepier and more irritated than those who got the placebo.

Research indicates that sleep debt — the difference between how much sleep you need and how much you get — makes it [harder to perform cognitive tasks](#). Four cups of coffee a day might prevent the decline at first, but as Doty shows, it soon proves no match for sleep debt. “There’s no chemical that can override it,” says Namni Goel, a research associate professor in psychiatry at the University of Pennsylvania’s School of Medicine, who wasn’t involved in the study.

Doty points to the so-called adenosine hypothesis as one possible mechanism. As sleep debt builds up, the thinking goes, so does the neurotransmitter adenosine and/or its receptors in the brain. As adenosine binds to its receptors, drowsiness sets in. At first, caffeine might be able to block those receptors, preventing performance declines. But as sleep debt mounts, caffeine fails to keep up with the buildup of adenosine, its receptors or both.

To be sure, Doty’s study looked at only what happens when people consume a constant dose of caffeine at specific time intervals. While the researchers administered caffeine at 8 a.m. and at noon, let’s be real: “A lot of people would have another cup, maybe two or three,” says Goel, who wonders whether increasing caffeine intake would counteract decreases in performance. Doty says she plans to answer this question in follow-up research.

If you anticipate a sleepless workweek, try clocking in 10 hours of sleep a night for a [few days beforehand](#), which will fill your sleep bank enough for you to power through, Doty says. Basically, “there’s no such thing as a free lunch ... Eventually, you’ll have to sleep.”

http://www.sleepmeeting.org/docs/default-source/default-document-library/sleep-39-as_final.pdf?sfvrsn=2%20target=