Normalization of Deviance

SOPs are **not a suggestion**

La caída de Ícaro, óleo sobre lienzo (Museo del Prado, Madrid)

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Most pilots have probably heard the story from Greek mythology about Icarus, the ancient aviator who flew too close to the sun and came crashing down into the sea. Since it was Daedalus, his father, who designed and constructed those wings of bird feathers tied with string and wax, it can be said that not only was he the original aeronautical engineer, but he included a maximum cruise altitude in his design specifications. Fly too high, he warned his son, and the wax used to fasten the feathers would melt. It can also be said that Icarus was the first pilot to deviate from design limitations.

Deviations in aviation are to be expected; in fact, regulations make allowances for them. Since aircraft designers and regulatory authorities can't think of every possible circumstance, 14 CFR 91.3 gives a pilot in command the authority to deviate from Federal Aviation Regulations to the extent required if an in-flight emergency requires immediate action. What about other deviations? Pilots may find themselves having to alter or skip a standard operating procedure (SOP) for safety reasons. Sometimes they may make decisions that, at the time, seem prudent. But on reflection, many of these decisions may have just been laziness or an error in judgment. Aren't we all human, after all?

Yes, we do make mistakes and much of our training is designed to prevent or mitigate those before they become harmful. As professionals, we train to minimize deviations and to recover from those that do occur. All that is as it should be. If those deviations become frequent, however, there is a tendency to start accepting them as the new norm, to lower our standards and blur the distinction between what is acceptable and what is not. And thus the normalization of deviance.

Challenger's Final Flight

The phrase "normalization of deviance" was coined by sociology professor Diane Vaughn in her 1996 book, The Challenger Launch Decision: Risky Technology, Culture and Deviance at NASA, where she examines the tragedy of the 1986 launch of space shuttle Challenger. The corruption of the decision-making process at NASA serves as a useful illustration on how very professional people can be seduced in to normalized deviance.

The space shuttle's solid rocket boosters (SRBs) were built by Morton Thiokol, which was quite literally the cheapest bidder. Each booster was 149 ft. long and 12 ft. in diameter, manufactured in six sections, and delivered to NASA in sets of two that were joined at the factory. The three combined sections were joined in the field with the help of two rubberlike O-rings and an asbestos-filled putty. The 1/4–in. diameter O-rings surrounding the rocket's entire diameter were designed to keep the hot propellant gases inside the rocket and directed downward toward the nozzles. The secondary O-ring was meant to be redundant, a safety measure.

NASA

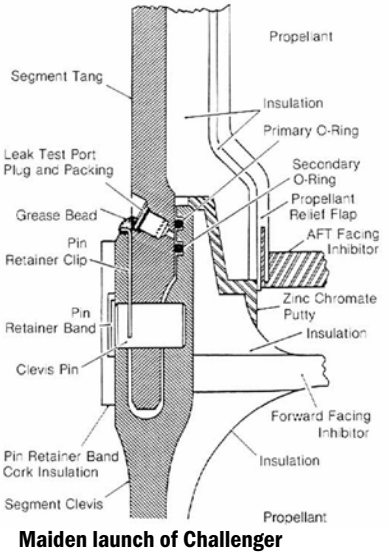
But early on in the program there was evidence of some "blow-by" beyond the primary O-ring. Engineers determined an "acceptable" amount of erosion in the O-ring and for a while these norms held up. Starting in 1984 the amount of damage to the primary O-ring was increasing. Engineers were initially alarmed but later became convinced that the damage was slight enough and the time of exposure was short enough that the risk was acceptable.

In 1985, some of the SRBs returned with unprecedented damage, the majority came back with damage, and in one case the secondary O-ring was also damaged. For one launch, there was complete burn through of a primary O-ring. In each case, the decision was to further increase the amount of damage deemed acceptable and press on. When it was no longer possible to say the two O-rings were redundant, NASA decided to waive the requirement.

What also happened in 1985 was a series of launch decisions in colder and colder temperatures. While the overall shuttle program was designed with a temperature range of 31F to 99F as launch criteria, the SRBs were never tested at the lower temperatures. In fact, Thiokol stated that O-ring temperatures must be at least 53F at launch, or they would become brittle and would allow "extreme blow-by" of the gases. There was also evidence that the O-rings could become cold soaked and their temperatures would take time to recover from prolonged cold. But top-level NASA managers were unaware of the SRB design limitations and the 53F threshold didn't hold firm. For one launch the engineers said, "Condition is not desirable but is acceptable."

Temperatures on the morning of Challenger's final launch were well below 53F. SRB engineers recommended a delay but NASA managers applied pressure on Thiokol management. Nevertheless, the engineers refused to budge. So, they elected to make it a "management decision," without the engineers, and agreed to the launch. It was 36F at the moment of launch.

The O-rings on one of the field joints failed almost immediately. About a minute after launch a continuous, well-defined plume from the joint cut into the struts holding the SRB to the main tank and the SRB swiveled free. The flame breached the main, which erupted into a ball of flame seconds later. The shuttle cabin remained intact until impact with the ocean, killing all on board.



Maiden launch of Challenger and O-ring diagram.

Much of the reporting after the event focused on the O-rings. After the accident report was published, the focus turned to NASA managers breaking rules under the pressure of an overly aggressive launch schedule. But as Vaughn points out, they weren't breaking any rules at all. In fact, they were following the rules that allowed launch criteria and other rules to be waived. The amount of acceptable primary O-ring damage went incrementally from none, to a little, to complete burn through. Over the years the practice of reducing safety measures with waivers had become normalized.

By 1986, there had been 24 previous launches, each cementing the soundness of the decision-making process. With thousands of highly qualified experts collaborating on many of the decisions, it was easy to think, "We know what we are doing."

But this was rocket science. How about an example closer to home?

The Final Flight of N121JM

Experts who have accumulated an enviable amount of experience and a strong sense of confidence are at risk of normalizing deviance unless they have sufficient oversight and a strong peer group. The crash of Gulfstream IV N121JM makes this case.

On May 31, 2014, the crew of the GIV started their engines without running the engine start checklist and neglected one of the steps that would have had them disengage the flight

Gulfstream IV N121JM wreckage NTSB

control gust lock. They then skipped the after starting engines checklist, which would have required the flight controls to be checked; had they done this, they would have realized the flight controls were locked. They also skipped the taxi and line up checklists, as well as the requirement to check the elevator's freedom of movement at 60 kt. They were unable to set takeoff thrust, realized this, but continued the takeoff anyway. The rest, unfortunately, is history.

As details gradually surfaced from the NTSB accident investigation, we in the aviation world were stunned. How could two pilots have been so inept? But their airplane was outfitted with a quick access recorder and we learned that this type of behavior was the norm for them. For example, the recorder revealed that they had skipped the full flight control check on 98% of their previous 175 takeoffs.

These two pilots did not fly in a vacuum. They regularly underwent formal (and not inexpensive) simulator training and had even passed their Stage Two International Standard for Business Aircraft Operations (IS-BAO) safety management system (SMS) certification. So, they were able to fool their instructors and auditors, and that served to reinforce the behavior as normal.

Why would two, highly experienced pilots give into the normalization of deviance? They had achieved an enviable place in aviation, flying a prestigious aircraft that might represent the pinnacle of any pilot's career. A psychologist would have a field day examining their ego-based complacency that had been reinforced by decades of successful operations without so much as a scratch to their expensive aircraft.

Unfortunately, there is compelling evidence that they were not alone in such reckless behavior. At the NTSB's recommendation, the NBAA conducted a review of data produced by 144,000 flights involving 379 business aircraft from 2013 through 2015 to determine adherence to required flight control checks prior to takeoff. In nearly 16% of the takeoffs, the pilots did only a partial check. In 2% of the takeoffs, pilots failed to perform any check of the flight controls at all.

Preventing or Curing the Problem

There are multiple paths to normalizing deviance. As in the space shuttle case study, we can become so focused on our mission objectives that we can rationalize away safeguards and common sense itself. We can also become convinced in our own greatness — we defy gravity for a living, after all — and that breeds the conviction that rules and regulations are "for the other guy." And finally, as we see repeatedly in aviation, we can become so experienced at our profession that complacency displaces competency. No matter the cause, these factors can combine to ensnare us into accepting deviance as our normal behavior.

As with many things in life, it would be best to avoid the trap altogether. But even if trapped, any pilot can claw their way out with the right mindset and a few techniques.

▶ **Follow standard operating procedures (SOPs).** We often find ourselves having to adjust, reorder or even skip some SOPs because they don't exactly fit the situation at hand, they would take more time than a widely accepted shortcut, or we think we have a better method. There are several problems with this behavior, of course. Operating ad hoc, in the heat of the moment, we risk not carefully considering all possible factors. If we skip or reorder steps, we risk forgetting something important or failing to consider any sequential priorities.

If we adjust an SOP on our own, crew resource management (CRM) becomes more difficult as others will have to guess about our procedures and techniques. Further, once we've violated the first SOP, it becomes easier to violate the second, and the third. Before too long the culture of having SOPs will erode and when that happens, all SOPs become optional. And in a small flight department, there is a low likelihood of "being caught" or challenged.

Any pilot who is tempted to deviate from an SOP should first think about measures to formally change the SOP. There is a definite art to this. You need to carefully analyze the existing SOP, try to understand why the SOP is constructed as it is, and come up with an improved alternative solution. Then, gather support from peers, and advocate the change to those who have the power to change things. Flight department leaders should work with crews to ensure that each SOP is pertinent, easily understood, easily followed and consistent with other SOPs in the department and fleet. If adjustments are needed, select a well-respected team member to spearhead the effort, institute a test phase and obtain manufacturer comments, if possible.

▶ **Train to a standard.** Your training is only as good as your instructor and if you are taught to cut corners and to ignore all that has been learned over the years, you can be trained to deviate. This most often occurs when someone you respect or someone in a position of authority assumes the role of instructor but has already given in to deviant behavior. It can also occur when a professional training vendor has misguided ideas of what should or should not be taught, or does not exercise proper oversight of its instructors. Seasoned simulator instructor pilots can give into the normalization of deviance, too, and their preferred methods are not necessarily the right methods.

Instructors and students alike should always be willing to return to the source documents. If an instructor's technique violates a manufacturer's procedure, the instructor is duty-bound to advocate the change with the people who built the airplane, not with those who are flying it.

Training administrators should realize that some courses are merely square fillers that satisfy regulatory requirements but do not teach meaningful information. Others can become repetitive because most vendors seldom change their courses from year to year. In either case, these courses will become boring and may actually become counterproductive. Administrators should seek honest feedback about each course and attempt to find alternate vendors, even for the good courses. A robust in-house training program can supplement these efforts and also serve to combat stagnation and complacency.

▶ **Improve and broaden your peer group.** Of course no professional

pilot sets out to bend the rules on the margins or flagrantly disobey all SOPs. But some end up doing just that. Good pilots can be corrupted by poor peer groups. If everyone else has already normalized deviant behavior, it will seem an impossible task to hold true to SOPs without upsetting the status quo. Even a good peer group can become so comfortable that it, too, will begin to accept deviance as normal.

No matter the cause, all it takes is one pilot to bring the rest of the group back into the fold. If just one pilot adheres to all SOPs and best practices, the others will take notice. That alone may be enough to fix what is broken.

It may also be possible to demonstrate the efficacy of an SOP against a deviation and attempt to convince your peers to participate. Years ago, as the newest pilot in a Gulfstream IV flight department, I was alarmed that the pilots followed a Do-Verify method for the after-engine-start checklist and often missed critical steps. I convinced them to put their procedure against the required Challenge-Do-Verify method and time them. We discovered that not only was CDV more accurate than DV, it was faster.

It could very well be that a majority of pilots in your flight department have the same issues with some nonstandard procedures and a group meeting to discuss the issues can solve the problem. You should obtain leadership buy-in first. Leadership may be surprised about the issue; you might be surprised how open to change they can be.

But what if the lead deviant is the boss? Greek philosopher Socrates taught conflict resolution through the use of probing questions. If a senior member of the flight department insists on a non-standard procedure, ask for the reasons behind that "to better understand how to accomplish the procedure." Having to verbalize the rationale may force a reexamination of the entire thought process.

When I first showed up in a Gulfstream V flight department, the pilots did not use any type of verification method prior to executing a change to FMS programing. I asked how this method would prevent an entry error that could misdirect the aircraft. After some thought, they agreed they had no such verification and were open to a new technique.

It is easy to fall into nonstandard behavior without an occasional look from someone outside the flight department. If the entire organization normalizes deviance at about the same rate, no one will notice because they are all involved. It may be beneficial to request an outside look at the workings within, such as a complete SMS audit that includes a flight observation.

However, keep in mind that some SMS auditors may make things easy in an effort to generate repeat business. If that happens, little is gained other than a piece of paper that says you filled a square. You need to emphasize to your auditors that you want an honest assessment because your overriding goal is to make a good flight department even better.

▶ **Make safety conspicuous.** One of the profound lessons of the Challenger tragedy is that decision makers believed they were making the right, reasoned ones each step of the way. But in hindsight they would have to agree that many of those decisions were wrong.

Pilots in the "expert" class are in remarkably similar circumstances. They are quite often under extreme pressure to minimize costs while expanding mission capabilities. Flight department managers are often asked to spend less and less on maintenance, training and operating costs. At the same time, their crews are expected to fly farther distances with correspondingly longer duty days. Skipping maintenance checks, training events and checklist steps are at first approached carefully with considerable thought and consideration. Formal waivers may have been instituted in an effort to do it "just right."

Before too long, however, the envelope of what was considered a deviation and what was just "normal operating practices" can start to merge. These decisions are rarely black and white and plainly labeled as "we are about to deviate from a procedure we once considered sacred."

A common problem in all types of professional aviation activities can be called "target fixation," that is we become so focused on accomplishing a mission we can lose sight of the need to do so safely. One way to keep a perspective of the organization's overall goal (i.e., moving people from Point A to Point B safely) is to always have in mind a backup plan (arrange alternate transportation in the event of a maintenance or weather problem, for example). By routinely briefing alternate plans, having to enact them may not seem too extreme a measure.

A poorly kept secret in many aviation circles is that the "safety first" motto is often quoted, but rarely enforced. Managerial actions, such as frequent duty day waivers and calls to "hurry up" can undo any spoken assurances. If you are a chief pilot and this alarms you, try to make a conspicuous show of it the next time safety is indeed first.

I once elected to scrub a trip because an aircraft stabilizer system was questionable. The manufacturer did not prohibit the flight but didn't recommend it, either. So we missed our first trip in several years because we decided the flight was too risky. I could have confined the matter to those directly involved but decided it was a good case study for everyone in the department to consider. They had to know that we really would cancel trips when the risks became too high. Safety is first.

▶ **Learn humility.** When we assign the title of "expert" to a pilot, we recognize that person for a technical skill gained from training and experience. We also imply that the expert will be more objective than a non-expert and will be better armed against the normalization of deviance. Unfortunately, the opposite can be true.

An expert can believe his or her knowledge and experience gives license to deviate. With experience comes confidence — in some cases to the extreme. Over-confidence and arrogance can be cojoined.

The antonym for arrogance is humility. A humble pilot realizes that even the best aviators make mistakes and that one's guard can never be lowered, even when the title of "expert" has been rightfully earned. The best way to keep humble is to research the all too many mishaps of very good pilots who have given in to the normalization of deviance. They're readily available. Go to **http://www.ntsb.gov**, and select the "Investigations" tab for full accident reports. Another great source is **http://www.baaa-acro.com**, the Bureau d'Archives des Accidents d'Avions.

Deviance is Not Normal

As with many technical pursuits, deviations from the norm are a fact of life in aviation. Our SOPs cannot cover every situation. We make mistakes. If those procedures are found lacking, it is up to us to change them. We must also design safeguards and redundancies to ensure we can effectively recover from any of those inevitable mistakes.

It is up to the Daedalus in each of us to ensure the equipment and procedures are well designed, and it is up to the Icarus in each of us to use the equipment as designed and adhere to those procedures. **BCA**