The T-44A Glider

By Maj. Rich Harrington, USAF

> Warning
>
> Poor CRM May Be Hazardous to Your Health.

It's inconceivable a crew of three pilots, flying on a clear VMC day, in a non-time-constrained environment, would, in unison, incorrectly shut down all their engines in flight. But, that's just what happened to my crew. This is the story of our human error—of a mishap that didn't happen but had the potential.

As a prior safety officer, I am convinced pilots break more planes than planes break pilots. This event adds to the database of what we already know to be true: Human error is the No. 1 cause of mishaps and, I believe, potential mishaps. I initially didn't consider my event to represent a routine threat to aviation, but to place it under the category of poor CRM makes it a routine threat to aviation.

The crew consisted of a student pilot, early in training on his eighth or ninth contact flight; an observer student pilot, with similar experience as a student pilot; and me, a current, proficient, and qualified instructor with 2.5 years and more than 1,000 hours in the T-44A. The mission profile was a student training, contact sortie, where maneuvers, such as approach to stalls and slow flight, are covered in a high-work area. We then do extensive pattern work. The aircraft had no major write-ups, and the weather was VMC.

One of the special syllabus items was to perform two evolutions of actual engine shutdowns and restarts in the high-work area. The intent of the training was twofold: to show the student how the aircraft behaves single-engine, with and without propeller windmilling; and to reinforce the different procedures to restart the engine after a precautionary shutdown and after an inadvertent shutdown. We also discussed these maneuvers in our preflight briefing.

The student did fine during start, run-up, and taxi. His departure was fine, except for a higher-than-average incidence of student dyslexia, such as when told to fly 110, he set and tried to fly 010. This behavior was something I should have been keener to consider, because we were about to start shutting down engines while airborne.

When we got to the high area, called Three Central, at about 8,000 MSL, we did some syllabus maneuvers. We then got to the engine shutdown-restart portion.

The first shutdown and restart was a starter-assisted airstart, where we simulated engine shutdown as a precaution, then restarted via a non-memory checklist. The student correctly identified the scenario and malfunction, and we shut down the left engine. During the shutdown and restart checklist, we needed to concur on certain steps to prevent shutting down the wrong engine. He made no mistakes shutting down the engine; however, during restart, he did make an error. In a challenge response-response manner, I called for and he pointed to the left power lever and confirmed it in idle. The same sequence is used for the left propeller to feather.

I called for left condition lever to fuel cutoff; however, he pointed to the right, the remaining operating engine, while stating "left" condition lever to fuel cutoff. I stopped him. I did not concur for him to shut down the right and only operating engine. I was proud to point out his mistake. I also pointed out this situation was why we have to concur on these critical items. He then pointed to the correct, left condition lever and continued the restart checklist without error.

I later realized part of our training may condition students to possibly look for the wrong lever during restarts. Usually, we simulate shutting down engines. The power levers are directed and concurred to set to idle power (aft position), but the propellers and condition levers are simulated and remain in their normal forward positions. In other words, the student is used to seeing propeller and condition levers in a forward position, rather than feathered or fuel-cutoff position (full aft). So, during our evolution, although the left engine had been shut down, with the left condition lever in an aft position, the student may have been looking for the left condition lever in a forward position, like he was used to seeing during simulated shutdowns. As a result, he reached for the only forward position condition lever (the incorrect, right or starboard condition lever). I previously had not considered him taking this action.

The next airstart, a windmilling airstart, was to be even more exciting. This maneuver corrects an inadvertent shutdown and is conducted via a memory item, concurrence-based checklist. I advised the student we were going to perform the maneuver and that I would simulate shutting off the fuel by catching the condition lever with my boot while getting out of the seat. I stated "simulated" three times, then cut off fuel by pulling the right condition lever to fuel cutoff. For the restart, he pointed to the right power lever and requested it to go to idle, and I concurred. He pointed to the right propeller lever and requested it go full forward, and I concurred. Then he pointed to the only remaining forward condition lever, the left one, and requested "right" condition lever to fuel cutoff, and I mistakenly concurred. As soon as the plane got very quiet, I realized the student and I had lost our situational awareness, and just had shut down our only remaining engine. We had become a glider.

Students and IPs train for a procedure called a dual windmilling airstart, which normally we use during a simulated, total engine-out, ditching exercise. This procedure is used when both engines are shut down with propellers windmilling, and you need a quick restart. I took control of the plane, used this procedure, and both engines quickly hummed back to life.

The event had caught me off guard, and I was embarrassed. I had let the situation develop, but I also was ready to continue training. However, I wasn't sure how the students felt. I discussed the situation with them and asked if they felt OK to continue training; they did, so we finished the rest of the sortie.

As I discussed with the student pilot what had happened, he profusely apologized, but the error was not his alone to bear. We both had made the same mistake: lost SA and, unfortunately, at the same time. From a CRM and former safety-officer perspective, I tried to reconcile and categorize this crew error to

see how it could have been prevented. Why did concurrence checklists work the first time, during the starter-assisted airstart, but not the second time, for the windmilling airstart? Clearly, the culprit was lost SA, but let's also consider failure of attention: cognitive error, complacency, and even defensive positioning.

SA versus cognitive error: When you look at something and misinterpret it, there is a point where your problem is a result of cognitive error or a lack of SA. This point is difficult to identify. The Navy's CRM school defines SA as the degree of accuracy by which one's perception of the current environment mirrors reality. In our situation, both crew members incorrectly perceived the situation, failed to realize only one engine was running, and were about to shut down that one engine. This situation points to a loss of SA.

The CRM school offers four techniques to help promote good SA: detect and comment on deviations, provide information in advance, identify potential problems, and demonstrate an awareness of task performance and mission status.

Detect and comment on deviations. As instructors, we do this all the time. I have been frustrated to this day in reconciling why I corrected the student's first deviation, his trying to shut down the wrong engine, but not the second. Did I lull myself into complacency, thinking he wouldn't make this mistake twice?

Provide information in advance. The T-44A can start both engines in flight after they are shut down. If that was not the case, procedures for shutting down one and restarting it might be different, with more controls in place to prevent the error my crew made. A mental reiteration of the situation just before concurring on shutdown would be beneficial. For instance, a reiteration of the fact the right engine was shut down and the left engine was the only one keeping us flying would have worked. I also could have said to make sure you don't shut down the left engine or manipulate its controls by mistake. A momentary pause to make sure the accuracy of the environment in advance of shutdown could have helped.

Identify potential problems. I had failed to do this effectively. I recognized the student was making dyslexic errors—more than average—but failed to predict and apply this type of error to our upcoming engine-shutdown situations, where the difference between left and right was critical.

Demonstrate awareness of task performance and mission status. Mentally restate that a student is about to shut down an engine (and students do make mistakes), and if you both make mistakes, no engines will be left to fly the plane. This assessment readdresses the importance of the situation.

Let's return to complacency, which falls under failure of attention as a performance error in OpNavInst 3750.6R appendix L, especially as it applies to defensive positioning. Complacency is a seemingly dirty word that's applied to several human-error situations. Most pilots, including me, consider themselves very conscientious, and to be labeled complacent is a bitter pill to swallow. In general, I would associate a lack a defensive positioning with complacency. Because logically, if you didn't think a student had the potential for error, you would not need to defend controls. Merriam Webster online defines complacency as "self-satisfaction accompanied by unawareness of actual dangers or deficiencies." A lack of defensive positioning clearly falls under that definition. During simulated engine shutdowns, IPs are taught to "pinch" together the propeller and fuel controls to make sure an excited student doesn't feather or shut down an engine unintentionally or incorrectly. Ironically, with one engine already shutdown and in a restart environment, I was not taught, nor did I practice defensive positioning. I basically had been relying on verbal concurrence.

If I had applied defensive positioning, would I still have made the same mistake and shut down the last remaining engine because of a lack of SA or cognitive error? Would my hands on the last forward condition lever have prevented me from concurring with an incorrect command? Or would the opposite have happened, and would I have been spring-loaded to pull back on the condition lever nearest my hand because that is what my muscle memory is used to doing? I found the answer the next time I flew and was scheduled to practice an actual engine shutdown and restart. I used both the techniques to avoid a loss of SA. By mentally reinforcing what the situation was and using defensive positioning, the procedure worked without incident. The steps to reinforce SA and defensive positioning clearly were effective.

What good things were in place that prevented this situation from developing into a mishap? OpNavInst 3750.6R references J. Reason's work on human error and the Swiss-cheese model that incorporates active and latent acts and conditions for errors. When latent conditions and preconditions line up from negative organizational influences through preconditions for unsafe acts to unsafe acts, mishaps will occur. The unsafe act of incorrectly shutting down all engines did not lead to a mishap because of preconditions preventing it, such as procedures, SOP, and even IP techniques. Here is a brief discussion of each precondition.

Procedures. After the second engine inadvertently was shut down, the dual windmilling airstart was performed, and the situation was corrected. Knowledge and execution of NATOPS procedures quickly remedied the situation and prevented a mishap.

SOP, or standard operating procedures, are embedded in guides and publications. The NATOPS procedure worked great, but some conditions specified in the flight-training instruction (FTI) further enabled success. Our crew was at about 8,000 feet when the incident occurred. Had we been at 1,000 or 500 feet, the time to get a restart would be more critical. Our FTI specifies a minimum altitude of 4,000 feet when performing actual engine shutdowns. Our FTI also specifies VMC all the way to the ground. Can you imagine the complications of descending into IMC while trying to restart engines. Normally, aircrew complain of restrictions placed on them because of SOPs; however, adherence to FTI-stated requirements, similar to SOPs, also prevented this situation from developing into a mishap.

Technique. I was taught always to turn off the air conditioning before shutting down an engine for syllabus training. The reason for this technique is that the air-conditioning unit uses about 60 percent of the capacity of one of the two aircraft generators. The generators work off rotating engines. During single-engine operation, when the engine is shut down and not rotating, the useful load capability of its generator also is lost. Over half of the remaining generator, running off the remaining engine, is dedicated to running the air conditioning. Overloading the remaining generator is possible with the air conditioning and all other electrical equipment on.

In this incident, with the dual windmilling airstart, the entire electrical load was placed on the battery to start both engines (fire the igniters). With about 150 amps (60 percent of a 250 amp generator—the AC unit) removed from a 42 amp-hour battery, more electrical power was dedicated to the start, which improved the chances for lightoff. A severely drained or dead battery would not have provided ignition for start. I believe my technique of reducing the electrical load in advance of intentional shutdown resulted in a higher probability for restart because the battery was under a lighter load when it had to fire the igniters for both engines for airstart.

A crew of three pilots, in unison, unintentionally shut down all the engines of their aircraft in a non-time-compressed situation in a clear, blue sky. This action was a result of poor CRM skills (lost SA) and complacency (lack of defensive positioning). However, latent positive preconditions (NATOPS knowledge, SOP/FTI guidance, and techniques) in Reason's Swiss-cheese model, prevented items from maturing into a mishap.

I will continue to use the four techniques to keep SA high and also to employ defensive positioning during actual single-engine work as a tool to prevent undesirable flight regimes from developing.

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