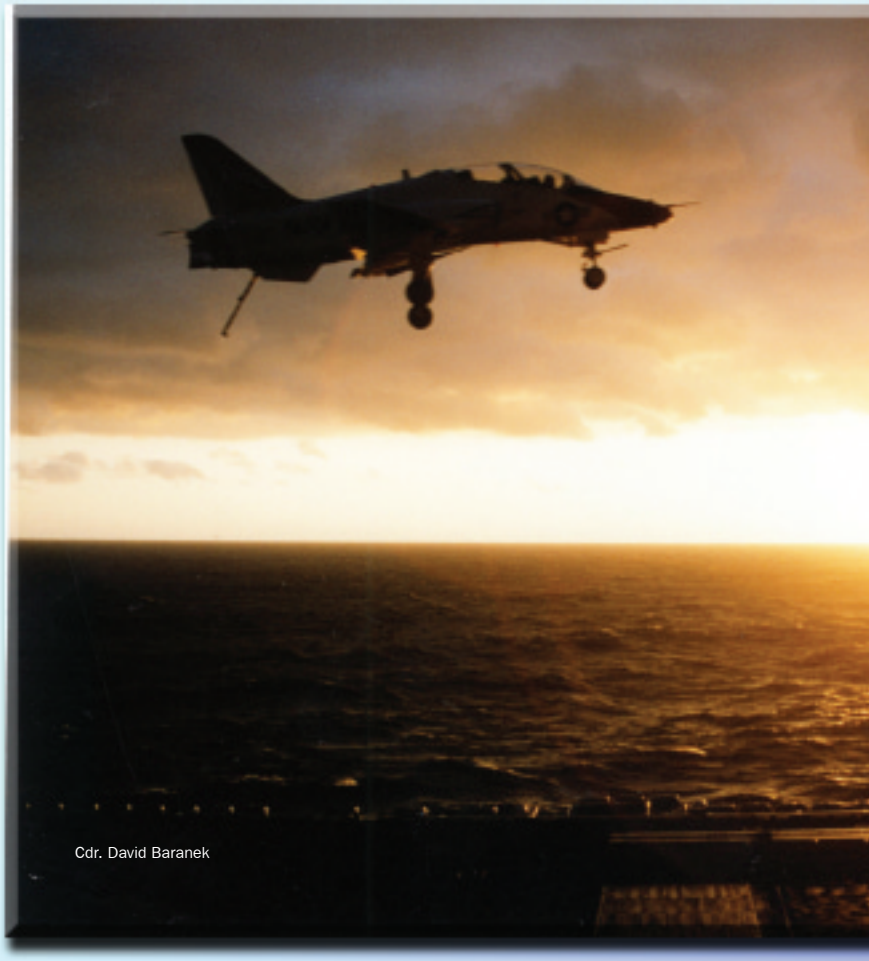
They may form a rigid scanning pattern, which precludes them from being able to flexibly change a scan pattern to fit a changing flight regime. IPs: Does this sound like your last problem student?

Aviators with considerable IFR flight time tend to maintain a scan that gives them sufficient data to adjust the controls but still maintain performance within the strictures of altitude, heading and airspeed requirements. Research has shown that experts also dwell on critical instruments for shorter times than do novices, who tend to fixate. The experts are better able to assimilate information, based on their expectations from the mental model.

How is scan taught? Aviators can learn how to develop good scans very early in flight training and in the simulator. However, teaching isn't standardized—it may be given short shrift or not taught at all. When scan is taught, instructors commonly employ a technique known as "guided training," whereby students are told which instruments to scan and when to scan them. The instructor assumes if the aircraft is not where it should be, then the crewman has not controlled the aircraft due, in part, to ineffective scan and cross-check techniques. Symptoms of poor scan include a student "chasing" the target data rather than controlling the aircraft, or a student fixating on specific targets rather than cross-checking data sources. Without monitoring scan behavior during unguided flight, there is no way to make sure any learning has occurred.

How should scan be taught? From the onset of flight training, students must learn to scan in a way that helps refine their mental model of the aircraft and tasks at hand. Instructors should provide a structured, standardized program aimed at teaching where and when to look, and why. Instructors must be able to assess how well the student understands the basics of flight through three dimensions. This can be done by verbal testing and the use of a scan monitor which is currently used in research, A scan monitor tracks eye movement and displays scan patterns. An instructor can tell the student if the scan strategy being used is optimal or not. This training would be incorporated into the formal training syllabus, scored and recorded. Evaluations are based on set standards rather than subjective grading that varies with instructors.

The officer in question was a good stick, an aviator who could get onto the carrier deck with no problem during daytime ops.



Cdr. David Baranek

When should scan performance be tested? It's most important at the beginning of primary flight training; it should be coupled with classroom briefs and reinforced in cockpit-procedure trainers and simulators. It also should be reviewed periodically, even for those who have

many hours of experience. Safety Center statistics suggest even expert crews are susceptible to scan breakdown. Tests also should be given when someone transitions to another aircraft (when they might switch from digital to analog instruments, or from head-up to head-down displays), or when a crew takes on a different type of mission. An aviator experienced in tactical flight may not have an effective scan for search and rescue.

What are the benefits of standardized scan training? Instructors can teach and test in a way that can be measured and replicated. They actually can observe scan performance rather than infer it, and students can get accurate, real-time feedback from the instructor.

Why scans break down. Even experienced crews aren't immune. The reasons for this are many and varied; here are a few commonly cited in hazard reports and safety investigative reports:

✍ **Distractions:** Communications, wandering thoughts, unexpected changes in aircraft state, and anything else that will get you behind the aircraft. By their nature, such distractions will interrupt or hinder the use of effective scan strategies.

✍ **Workload**: This is a big problem, especially when the mission is complex and hazardous and you aren't well-prepared. Workloads have a way of increasing very rapidly when an unexpected problem arises, especially during critical parts of a mission (e.g., a moonless night, bingo fuel state, or when you're in the groove and suddenly lose hydraulics).

✍ **Automation**: One of the paradoxes of having more automation in the aircraft is that while it may assist you with some chores, your workload also may increase. If you have low trust in your automation (perhaps it is faulty half the time), you may not use it, or you may try to counteract its effects. On the other hand, you may become over-confident in your automation and, in doing so, become lax.

✍ **Display design:** The use of certain visual displays (e.g., helmet-mounted and panel-mounted, multi-function displays) can lead to scan breakdown. Crews become totally reliant on the MFD images, and their gazes may become transfixed in a manner similar to that experienced during normal television viewing. This "electric jet syndrome" is hard to overcome and often contributes to mishaps.

Conclusions: By now, you can see how important it is to have and use a set of effective scan strategies. However, this article only scratches the surface of this critical issue. For more information, contact your aviation safety officer (ASO). All ASOs graduate from the six-week aviation safety course offered at the Naval Postgraduate School, which includes study in human factors. With this background, the ASO joins your flight surgeon, aviation physiologist, and aviation experimental psychologist as your organization's human-factors team. They are there to make sure you and your shipmates safely complete your mission and, in doing so, help to maintain your unit and the fleet at peak operational readiness. Indeed, maybe they can help all of us steer clear of an FNAEB or FFPB!

For more information contact Cdr. Bellenkes at: ahbellen@nps.navy.mil

Cdr. Andy Bellenkes is a professor and Capt. John Ford is the director at the Naval Postgraduate School, School of Aviation Safety.