Welcome to OZ

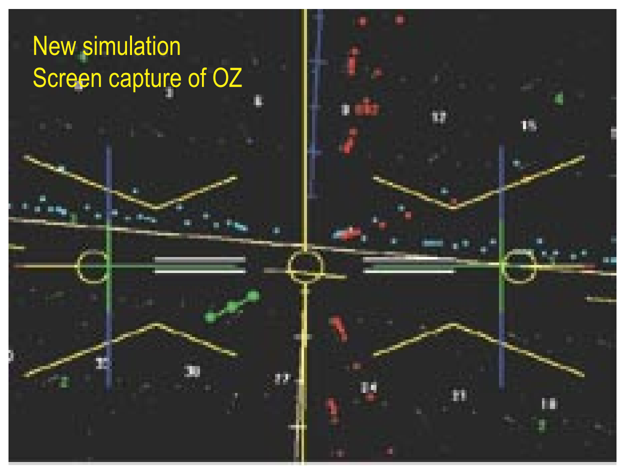
By Leonard A. Temme, Ph.D.

Spatial DISORIENTATION

"Quite possibly, I believe, OZ may represent the most significant step forward in instrument flying since Elmer Sperry invented the artificial horizon in the 1920s." That is the opinion John Sheridan expressed in his article on OZ, published in the June 2003 issue of *Aviation International News*, a leading magazine for senior aviation business personnel.

I agree with Sheridan, but I really can't be objective about it because I'm one of the two people who invented OZ. It's especially heartening when a crusty pilot with more than 4,000 hours stick time, like Sheridan, so strongly praises OZ. For the curious, the OZ name came from the need, during early experiments, to have a rear-projector operator behind a curtain, reminiscent of the 1939 movie.

OZ was born at the Naval Aerospace Medical Research Laboratory (NAMRL), where I work as a research physiologist. It is the result of at least six years research collaboration with Dr. David Still, who was on active duty as a research optometrist at NAMRL. When Dave retired from active duty, he joined the Institute for Human and Machine Cognition (IHMC), also in Pensacola, so we're still working together on OZ. The Navy and the IHMC jointly own the OZ patent.



Both pictures represent the same aircraft situation. Can a change in instrumentation help a pilot avoid or recover from SD?

OZ grew from two projects. One was a study of instrument-scan patterns. We had put an eye tracker in one of the motion-based, high-fidelity, helo-training simulators at NAS Whiting Field and used it to record the scan patterns of student pilots as they went through their basic and radio-instrument training.

Although I'm not a pilot, I appreciated what the pilots were saying as they explained to me why instrument flight is so difficult. At the very least, it takes about a quarter of a second to look from one gauge to another. If you're monitoring six gauges, that's nearly two seconds before you come back to look at the same gauge a second time. A lot can happen with an aircraft in two seconds. Add to the instrument-scanning task all the headwork you're doing to understand what the instruments are indicating. And, don't forget you're doing this while ignoring what your inner ear and other bodily sensations are telling you about gravity and inertia—because they're wrong. You're telling yourself to believe the instruments, and, sometimes, this trust is counter-intuitive, and every successful instrument pilot knows it.

The other study concerned the impact of night-vision devices (NVD) on flight. Maintaining spatial orientation in the restricted field of NVDs compounds these problems for the military aviator. Dave and I believed there was a better way to conduct instrument flight. After all, no one wants to fly on instruments when they can fly with an outside visual scan. The reason why is obvious: The instruments are user-hostile.

One day, I saw a picture of Jimmy Doolittle's 1929 instrument panel, the one that he used to make the world's first controlled, blind landing. I recognized the instruments; they were the same ones the pilots were learning to use in the helo simulator at NAS Whiting Field. The instruments hadn't changed in 70 years, but, of course, the aircraft have. Modern aircraft with 70-year-old instruments—amazing.

Dave and I knew we could do better than that, so we started designing a suite of cockpit instruments that essentially turns IFR into VFR, and, in a nutshell, that's what OZ does. Actually, we thought modern technology might make IFR easier than VFR.

We had several design goals for OZ. Primarily, it should provide all the information to the pilot in the same way the pilot gets information when he looks outside the cockpit. OZ should provide a panoramic (360-by-180-degree) map of airspace in a visually compelling fashion. This map could be used as a single frame of reference for the engine and radio instruments, and then be put together as a picture for the pilot. This setup should reduce the workload needed for a pilot to stay ahead of the aircraft. In doing this, OZ should not lose or bury any information in hidden or covert calculations, but make all the information available to the pilot. If OZ could do that, we figured it would help combat spatial disorientation.

Recently, we completed a study of OZ, in which 36 instructor pilots from Training Air Wing 6 at NAS Pensacola volunteered to compare flight with OZ to flight with conventional instruments. The pilots flew NAMRL's high-quality, research-grade, desktop simulator in a straight-and-level, slow-flight task—slow enough to make the simulated aircraft dynamically unstable. The pilots were breathing air equivalent to 18,000 feet for 13 minutes for each display, so they were slightly hypoxic. To make the air equivalent to 18,000 feet, we used a small, portable, computer-controlled device also invented at NAMRL. The idea behind the experiment was that the pilots would fly OZ better than with conventional instruments, even if they were hypoxic. That's what we found: By using OZ, a pilot would have more time to recover in an emergency.

The pilots told us the experiment—being hypoxic while performing a flying task—was a worthwhile training experience they could not have achieved in the altitude chamber. NAMRL's small, portable device that simulates altitude by reducing the oxygen content of the inspired air has a future for training.

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Contact Dr. Leonard Temme at temme@namrl.navy.mil or Dr. Dave Still at dstill@ihmc.us for more information and how to fly OZ on your computer. –Ed.