HUMAN ERROR Violations in Paragliding and Hang Gliding

by Frank Drews

Paragliding and hang gliding require pilots to not only be aware of the conditions they fly in and be familiar with the equipment they use, but also to be aware of the factors that impact pilot performance. To better understand what affects pilot performance, we need to understand what increases the likelihood of error and violations, since those can ultimately result in equipment damage, injury, or death.

Psychologists have studied error for about a century, and over time the ideas of what causes erroneous behavior have changed dramatically. Initially, researchers thought that error-prone people made mistakes and, as such, were solely responsible for their failures. Today, researchers believe that error results from the interplay of several factors.

A model of human error can be applied to paragliding and hang gliding. The goal is to help pilots gain insight into what factors may affect their behavior and outcomes. Understanding these factors can help pilots avoid falling into some typical traps that lead to accidents, thereby helping us to fly more safely.

Figure 1 (following page) provides an overview of one model of human error that will be discussed in detail. (Terms used are defined in the text that follows.)

COMPONENTS OF A HUMAN ERROR MODEL

LATENT CONDITIONS. Latent conditions are factors that indirectly influence safety, because they are removed from our direct actions. For example, glider certification and training requirements can create latent conditions that might influence your safety while flying. Some recently released paragliders are faster and more dynamic than their advanced-level predecessors, but were certified in an entry-to-medium level glider category. This situation creates a *latent condition* and raises doubts about certification procedures and their

LEFT Launching from Steptoe Butte, WA | photo by Karl Specht.

credibility. By purely relying on the certification class, a pilot may expect a certain glider recovery behavior. However, because of the changes in flight characteristics of the gliders, the recovery behavior is potentially more dynamic (possibly due to the behavior observed within the narrow certification conditions, not mapping into behaviors outside the certification context). If a pilot avoids flying in challenging conditions by soaring ridges only, he would not be aware of these glider characteristics, making this a latent condition, because other factors need to be present as well in order to contribute to error.

Another example is how the stabilo line is visibly marked on paragliders. Recent gliders identify the stabilo line by using a different thread color for the loop, rather than using a distinct color for the line (at least in the lower cascade). This more subtle indication in itself does not create problems. But in combination with a pilot's flying the wing in active conditions, this can result in problems when a cravat cannot be removed because the pilot cannot find the stabilo line as a result of its lack of distinctive marking.

Latent conditions can be present for a long time without any impact (think of the ridge-soaring-only pilot). However, in conjunction with other factors (that is, *active failures*), they can result in negative outcomes.

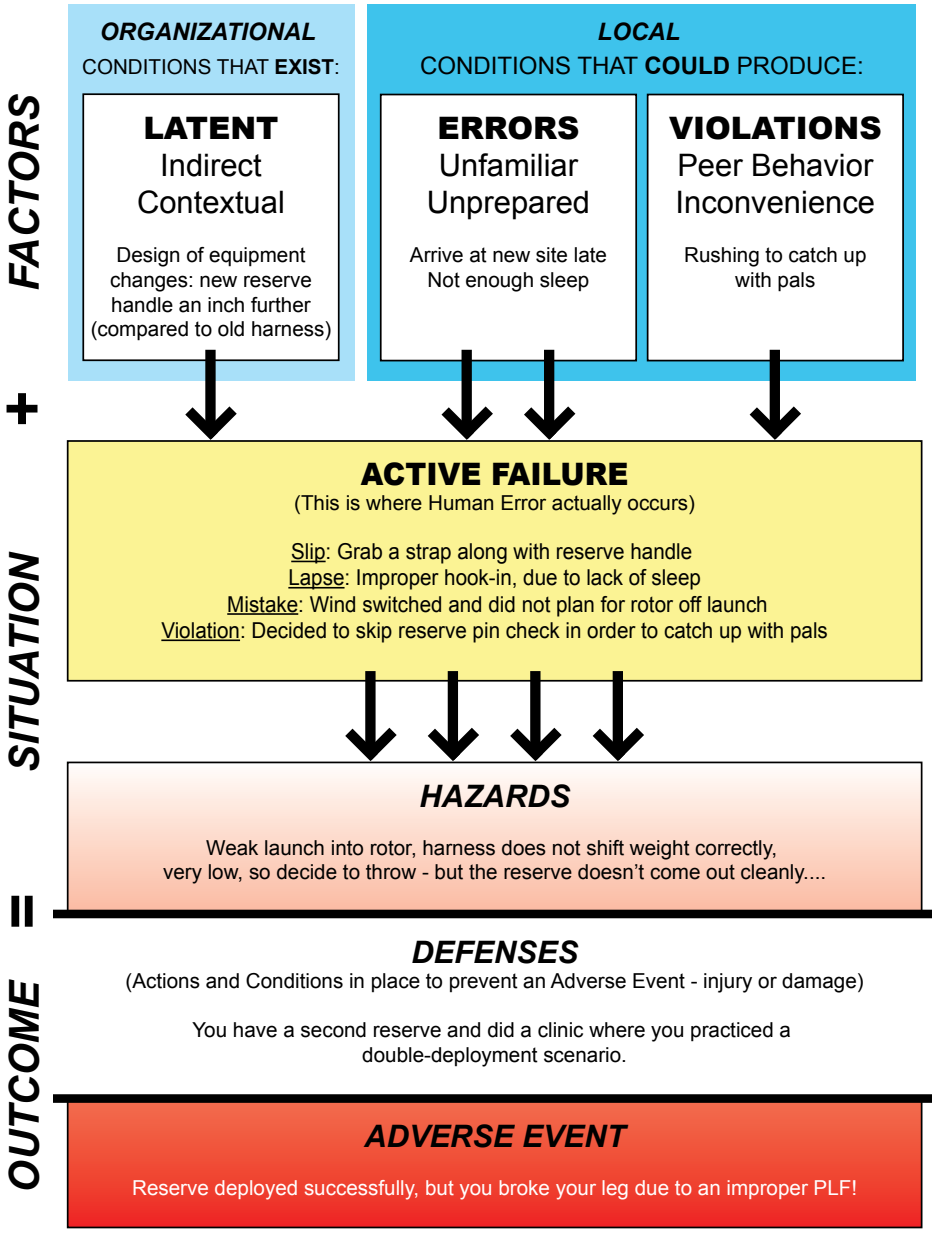
ERROR-PRODUCING CONDITIONS. Error-producing conditions make it more likely that an error will occur. Among the *error-producing conditions* in paragliding and hang gliding are: unfamiliarity with the equipment, terrain, or conditions; time pressure; misconception of risk; inexperience; and sleep deprivation. For example, flying at an unfamiliar launch, performing an unfamiliar maneuver, and flying sleep-deprived will all together increase the likelihood that an *active failure* occurs.

VIOLATION-PRODUCING CONDITIONS. Violation-producing conditions make violations (for example, deviations from the preflight checklist) more likely. Experiencing peer pressure (that is, seeing all of my buddies launch quickly) may make it more likely that I will omit my pre-flight check to quickly join my friends in the air. Inconvenience (having to walk back to my car to get my radio) and copying peer behavior ("none of my friends repacks their reserve annually") are other examples of *violation-producing conditions*. In the first case, they may make it more likely that I will fly without my radio, in the second, that I may not get an annual reserve repack. However, as a safety-aware pilot, I understand that these situations may tempt me to fly without a radio/not repack my reserve, but I can *decide* not to commit these violations of best practices.

ACTIVE FAILURE. Active failures, in conjunction with latent conditions, can lead to hazards. *Active failures* occur in the current situation, and they include slips, lapses, mistakes and violations. The difference between the first three and the last is that their occurrence is not intended, while violations are intentional. For example, after hearing that none of my friends repacks their reserve annually (*violation-producing condition*), I may decide to intentionally violate the common best practice of an annual reserve repack (an active failure in the form of a violation) and copy my friends' behavior.

Slips are errors of execution; that is, although I have the correct intention, I execute the action incorrectly. For example, I may pull the outer A-line instead of my stabilo line when at-

❶ Elements of a theory of human error based on work from James Reason



tempting to deal with a cravat, partly because the lines look similar (*latent condition*). A lapse is a memory problem that involves forgetting a step in a procedure. I may forget to check the position and attachment of my reserve handle during my preflight check (partly because I feel time pressure—*error-producing condition*). Finally, a mistake is when I have a plan that is incorrect to begin with. For example, I may fly close to terrain in hopes of finding some ridge lift, but since I did not think about the dominant wind direction, I may end up in a rotor.

HAZARDS. A hazard results from the combination of an unsafe act with a latent condition. The difference between a *hazard* and an *adverse event* is that the latter results in harm (by definition), while a hazard may not. An adverse event may be prevented by *defenses* (see below) that are in place. However, if the defenses do not work or are ineffective, a hazard may result in an adverse event. *Hazards* are frequent, and often pilots may not be aware of them, since there is no negative outcome. However, good pilots recognize hazards and avoid them. Analyzing when we realize that we were exposed to a hazard is important. We need to understand when "we got away with it," so we do not repeat such potentially dangerous behavior or put ourselves in those potentially dangerous situations.

DEFENSES. Defenses are put in place to protect or reduce the likelihood of negative outcomes as a result of your errors or violations. Two types of *defenses* exist: hard defenses and soft defenses. Our reserve parachute is an example of a hard defense. If successfully deployed, the reserve likely saves us from injury. Soft defenses involve people. For example, training may allow a pilot to address the hazard of a full frontal collapse after flying into a lee rotor. Having the skill to deal with the predictable collapse provides a defense that may work many times, but that also may fail. A better defense is to avoid flying into rotor! Equipment redundancy serves as a defense; for example, flying with two reserves will likely allow deployment of at least one reserve, even in the case that the other reserve cannot be deployed.

ADVERSE EVENT. An adverse event involves an injury to us or to others, or damage to our equipment or the property of others. However, we can distinguish *non-preventable adverse events* where there is an injury despite the best of all preparation and caution, from *preventable adverse events* where there is an injury due to a non-intercepted serious error. Because not all factors that influence an event are within our control, there is always a good chance that we may encounter non-preventable adverse events in paragliding or hang gliding. However, knowing what we can control allows us to manage the risks that are associated with our sport.

WHERE DOES THIS LEAVE US?

Having learned about human error and its contributors can make you a better pilot. If you fly mindfully and know and analyze the potential contributors to error and violations, you can fly more safely by actively managing the risk. The problem in our sport is that our wings do not have high resilience: a single problem can escalate quickly and force us down, while other aircraft are more forgiving. Thus, understanding the precarious nature of paragliding and hang gliding, and preparing for it, will help you to have many safe flights in the future.

It is a common misconception that the success or failure of a flight starts with the takeoff. With this article I have tried to demonstrate that many factors that contribute to success or failure of your flight are put into place well before your takeoff, or even before your launch preparations. By recognizing these factors we can be a little bit more insightful about what makes a flight safe and, hopefully, we will have more safe flights as a result.

Frank Drews is a Professor of Cognition and Neural Science at the University of Utah. His areas of research include cognition in context, human error in medicine, human factors, and visual attention. He is an H-2 and P-3 pilot and member of the Accident Reporting committee. Frank won the 2014 Rat Sprint on a Gin Carrera.

[1] This article applies to both sports, but is written primarily from the perspective of a paraglider pilot.

[2] The term violation is used broadly; it includes deviations from recommendations, safe operating practices or procedures, standards, or well-established rules of thumb.