Human Factors in General Aviation

Have you ever read an article about an aircraft crash, and asked the question “how could that have happened?” With the history of efforts in the aviation industry being focused primarily in technological development, the deficiency in this ideology began to make itself very clear with the occurrence of several high profile accidents. After the disaster at Tenerife, human error causing the ground collision of a Pan Am and KLM Boeing 747 in March of 1977, many in the industry began to realize the consequences of advancing the mechanical element, while neglecting the human one. It was at this point that the understanding of human factors began to get the proper attention.

Human factors is not a new area of study. According to most history books, official research dates back to the late 19th Century and was done for the sake of improving factory output. The USA Human Factor’s Society, founded in 1957, asserts itself to be an interdisciplinary organization of professional people, involved in the understanding of human characteristics that are applicable to the design of systems of people, machine, and environments. Although the majority of human factors study in aviation is concentrated in commercial operations, much of the research in areas such as understanding human error, vision and illusions, the effects of fatigue, body rhythms, and communication theory can all be applied to GA.

The field of aviation is not without its myths; many times have there been aircraft accidents attributed to “pilot error,” as if to signify a difference between that and all other forms of human error. The fact remains that just like a mistake made on a surgeon’s table or by a police officer on duty, the errors made by aviators are in principle, no different. One way to state how an error is committed is that of an operator’s decision making in action taken or lack there of. Rationally speaking, an individual can either take an action when he shouldn’t have, not take an action when he should have, or take the wrong action. A good example of not taking an action when required would be the individual who has become fatigued after a long flight, and forgets to put the gear down on final approach, or the individual who neglects to stop for fuel before attempting to conclude a long cross-country flight with a headwind. Further more, a situation involving the opposite would be when the student pilot brings the flaps down above VFE. Anyone who flies multiengine aircraft is probably familiar with taking one action when another is required, considering the throttle quadrant during an engine failure trouble-shoot. In the review of NTSB accidents, one could say the most common is inaction. The result is from either the need for action being missed entirely, an underestimation of the problem requiring action, or a simple case of indecisiveness. This is not to suggest that impulsivity is the answer least one of the other two mistakes is made, but rather to be decisive and stay proficient, not just legal.

Another concept in human error is that of the error chain as has been documented by the NTSB. The principle of the error chain is that of a snowball effect; one error will cause the result of other problems, be it additional human errors or other factors, until the demise of the flight. An example would be the individual who attempted VFR into IMC conditions followed by a vacuum pump failure, and decent into mountainous terrain;
none of the three alone caused the accident, but rather compounded. Therefore, don’t take
a chance assuming that it will be the only one you take in the flight.

The pilot’s condition will only add to the problem. If there is one thing that
influences pilots’ decision making as much or if not more than the corporate pressures
experienced by career pilots, it’s the condition of one’s body. For those of us who
exercise and stay healthy, or at least make an attempt to, we can naturally expect to be
able to push ourselves a little farther than average. However, no one is immune. As
pilots, we’ve all been taught acronyms such as “I’M SAFE,” illness, medication, stress,
alcohol, fatigue, and emotion to evaluate our physical state. However, due to time
constraints, private pilot training has never really taken more than a basic look at any of
these factors.

One of the more common factors, fatigue, can be attributed to a number of causes;
one being simply the lack of sleep. Whether it is due to a poor night’s sleep, or a vast
number of hours since you’ve slept, the effects can be greater than one would expect.
Studies by HF researchers have shown the mental acuity of the average human, after
being deprived of REM (Rapid Eye Movement) sleep for more than 16 hours will be the
same as if they had a blood alcohol level of 1.0. This is not to suggest that even simple
tasks should not be attempted after this point; however, considering the degree of
concentration and decision-making that flying requires, the go no-go decision should be
given additional thought.

Even with a good night’s sleep, sometimes other factors such as disturbed body
rhythm activity, or intense physical and mental activity can come into play. Most of us
have experienced the effects of the latter after a long day at work; however, the assumed
causes of Jet Lag are sometimes confused. The feeling of drowsiness, irritability, lack of
motivation, and in some cases mild depression after a long flight have lead many to
believe that it’s caused by the distance traveled; in actuality, it is the result of a change in
time zones. Your body has a set schedule called Circadian Rhythm, to which it performs
its functions. Research has found that by disrupting that schedule by several hours, your
body will require time to adjust.

Another physical condition, resulting in the temporary inhibiting of a pilot’s
ability to perform is hypoxia. According to training information at Edward’s Air Force
Base, there are four types; hypoxic, hypemic, stagnant, and histotoxic. Unless you have
not complied with the proper maintenance required on your exhaust manifold, perform
aerobatics, or drink a lot, the one most common to pilots is hypoxic hypoxia, the lack of
oxygen to the brain due to a lack of its concentration in the environment. The decrease in
air density, just like its effects on the human body is exponential with altitude, resulting
in mass per volume being cut in half at only 18,000 feet. At this altitude, the average
human has about twenty minutes before reaching a mental state such that performing
duties as PIC would be impossible. This may not seem very short as you’re sitting down
reading this article; however, flying a high performance aircraft at the threshold of Class
Alpha airspace can make time go by faster than would be anticipated. At twenty-four
thousand feet, the average person has approximately three to five minutes of
consciousness. In the event of a slow cabin decompression or pressurizer failure, without supplemental oxygen, the problem could be realized too late to do anything about it. FAA regulations require the crew of any flights above 12,500 feet cabin pressure altitude for more than 30 minutes, or any flights above 14,000 cabin pressure altitude to use supplemental oxygen.

Anyone who flies aerobatics will tell you that eyesight is actually the first sense to be affected by hypoxia, with a loss in color vision, followed by peripheral, and finally complete blackout. This is due to the oxygen requirements of the two types of light cells in the eye. Optical physiology shows the cones to be located in the center of the back of the eye, being responsible for color, detail, and daylight vision, and the rods around the edge of the back of the eye allowing for peripheral and night vision. This would explain why if you detect movement at night, it will be more noticeable in your peripheral than forward vision.

Jeppesen’s training information has also revealed several illusions associated with sight in aircraft operations. Two of which are with regards to approach to landing. One is that of the black hole effect, the illusion that one is flying at a higher altitude than actual on final, and/or is straight and level instead of actually in a bank. This is due to the lack of ground cues from unlighted terrain beneath the aircraft, hence “black hole.” Another visual illusion on final approach is a result of runway width. Landing on a runway more narrow than what one is used to will give the impression of a higher than normal approach and visa versa. The ways to counter the effects of these illusions is first realize that they exist as well as why, and supplement visual cues from other sources.

A separate topic that human factor’s study has made progress in is communication. Considering that almost ¾ of the reports received by NASA’s ASRS reporting system involve some form of communication error, aviation psychology researchers have shown a particular interest. According to their work, there are four elements required for communication to take place: the sender, the message, the medium, and the receiver. The sender involves who or what is sending the message; it could be ATC communicating a clearance, a system in the cabin communicating information about the aircraft, or the pilot communicating a control input to the aircraft. The message involves what is actually being communicated, I. E. the clearance by ATC, a complaint by one of your passengers, or an indication from one of your aircraft’s gauges. The medium is how the message is sent: auditory or visual, over a radio, data uplink, or in person. The receiver is obviously, who receives the message and is not always who the message is intended for: aircraft with similar N-numbers. Considering the complexity involved in every bit of communication, the reason for the number of problems that arise should be very clear. As pilots, be it ATPs, instructors, or weekend flyers, it is imperative that clear concise communication be consistently exercised least we become a statistic, or turn others into one.

In any aircraft operation, the most important aspect to understand is that of the human operator. The aviation industry is ever growing, being regulated, and continuously under the eyes of the public trust. We as the pilots, should be seeking to maintain that
trust in understanding not only what makes the aircraft we fly tick, but what makes us tick. With our own understanding and improvement comes increased confidence and control, two things a pilot cannot fly without.

Bruce Anzalone – Intern – Air Safety Foundation