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Pilot Your Life Decisively for Well-Being and Flourishing

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Pilot Your Life Decisively for Well-Being and Flourishing

Abstract

I have been a pilot, aviation instructor and FAA Pilot Examiner for over 40 years. Aviation requires a “pilot in command” mindset consistent with the tenets of positive psychology. This paper explains and advocates for this daily empowered, adaptive decision making process used by pilots in aviation as a necessary life skill to eliminate mind wandering and disengagement and optimize human performance consistent with the goals of positive psychology. Exploring the concepts of “pilot-in-command” (decisive control and self-efficacy) and “situational awareness” (alert mental functioning) I will offer techniques and suggestions for developing and deploying these critical skills in everyday life. I will examine the heuristic-based, “fast and frugal” (time and data limited) decision-making used every day in aviation and apply this to life for optimal performance and flourishing for individual lives and organizational effectiveness.

Keywords

decision-making, self-efficacy, heuristics, pilot in command, situational awareness, fast and frugal, metacognition, executive function, mind wandering

Disciplines

Curriculum and Instruction | Educational Assessment, Evaluation, and Research | Theory and Philosophy

Comments

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Pilot Your Life Decisively for Well-Being and Flourishing

David St. George

University of Pennsylvania

A Capstone Project Submitted

in Partial Fulfillment of the Requirements for the Degree of

Master of Applied Positive Psychology

Advisor: Barry Schwartz

November 11, 2015

Pilot Your Life Decisively for Well-Being and Flourishing
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I have been a pilot, aviation instructor and FAA Pilot Examiner for over 40 years. Aviation requires a “pilot in command” mindset consistent with the tenets of positive psychology. This paper explains and advocates for this daily empowered, adaptive decision making process used by pilots in aviation as a necessary life skill to eliminate mind wandering and disengagement and optimize human performance consistent with the goals of positive psychology. Exploring the concepts of “pilot-in-command” (decisive control and self-efficacy) and “situational awareness” (alert mental functioning) I will offer techniques and suggestions for developing and deploying these critical skills in everyday life. I will examine the heuristic-based, “fast and frugal” (time and data limited) decision-making used every day in aviation and apply this to life for optimal performance and flourishing for individual lives and organizational effectiveness.

Pilot Your Life Decisively For Greater Meaning and Fulfillment

I have been a pilot in many kinds of airplanes for over 40 years, accumulating over 15,000 hours in the air and over 45,000 landings in all kinds of weather. For the last 25 years I have also been a flight instructor and managed an Federal Aviation Administration Flight School, graduating thousands of people who flourish in careers as pilots. Our graduates fly for the airlines, the military and corporate aviation every day throughout the world. Aviation is by nature a demanding, high-performance occupation. Flying is a high-stakes, time-critical occupation where you never rest on your accomplishments, every flight and every landing is a test of skill, awareness and endurance. Though less than 1% of our population ever become a pilot, these skills are valuable and accessible to everyone.

In addition to being a rewarding occupation, piloting and flight training is also for me a wonderfully exciting psychological laboratory of life challenges and decision-making. I have been privileged to study and coach these skills on a daily basis for many years and thousands of hours. Educating pilots is my true passion and I serve the FAA as a Master Flight Instructor and also as a Designated Pilot Examiner. This means I not only teach pilots for all their certificates but also perform their practical tests to ultimately issue pilot certificates at all levels. These tests range from private pilot level to multi-engine Airline Transport Certificates, e.g., driving a Boeing.

This amazing transformation from terrestrial biped to confident and proficient pilot is a challenging and exciting process I am privileged to witness and guide on a daily basis. From many diverse backgrounds, individuals undergo an extensive educational process and in as few as 35 hours of flight training transform from merely walking in a

two-dimensional world to piloting themselves and their loved ones over the whole United States in a small airplane! If they continue their education they may ultimately land on an aircraft carrier day and night for our Navy or fly a Dreamliner to South America for the airlines. As you can imagine this process is an intense and challenging experience requiring a diverse range of skills, knowledge and judgments. Pilots under my care and supervision learn to successfully cope with fear and function effectively in charge of many complex, high-stress and time-critical operations. They need to master the skills of self-calming, and maintain confident control of every situation in a self-efficacious manner. Maintaining an alert state and avoiding complacency during routine times is also part of the training. The FAA tests require standard, pre-determined operations but also challenging problems in decision-making and survival. We will discuss their process of heuristic “fast and frugal” decision-making i.e. limited time and data, and how this process can help every person in daily life. Aviation often happens in an intense, high stakes, time-critical environment that demands accomplishing important activities accurately. It takes a commitment to excellence and mastery with little tolerance for error in an environment of physical risk. The results of failure are usually injury or death for the pilot and the passengers on board. Consequently, the training and testing are fairly rigorous. Superb emergency performances such as Sullenberger and Skyles’ “The Miracle on the Hudson” are studied, dissected and used as exemplars of decision-making in our aviation world. Metal toughness and resilience are obviously a critical part of the training and daily experience.

Education is always exciting because it is by nature a guided transformation and creation process, enabling and carefully coaching emergent talent into fully functioning

performance. In aviation, training people to cope and succeed in diverse situations and then watching them perform in a testing environment is a fascinating experience and always surprising. I am convinced these skills are not only valuable for piloting an airplane but are also valuable in everyday life to achieve a fulfilling and meaningful existence. Research in positive psychology indicates the natural state of a human is learning and growing to achieve a fully optimized, flourishing existence. Unfortunately, current studies indicate the average human spends over 47% of their time “mind wandering.” This is obviously not optimal: “...a human mind is a wandering mind, and a wandering mind is an unhappy mind.” (Killingsworth & Gilbert, 2010) Only 13% of workers worldwide are engaged in their daily jobs and 26% are actually actively disengaged. (Crabtree, 2013). Estimates indicate that 95% of our daily decisions are made sub-consciously without thoughtful consideration (Zaltman, 2003). As a population, we are not piloting our lives at all but floating through without meaning or mastery. The human disengaged, “default mode network” of brain functioning has been shown to be not only ubiquitous but also conducive to harmful rumination and associated with very negative depressive tendencies (Dutta, McKie, & Deakin, 2014). Other problems that result from failure to decisively direct our lives are the increasing flow of distracting and often useless data that streams at us from a variety of sources and the increasing pace of daily life. We endure endless information “noise” in our daily lives with very little useful “signal” in our modern communications. Our resulting excessive “cognitive clutter” leads to a helpless feeling of confusion and always rushed with no time for what is meaningful in life. It is critical to eliminate this rush and create a silent moment of reflection in our lives. We need space between action and reaction for

reflection to accurately decide and also, as we shall see later, to let wisdom work in our lives. We will decode the interaction between agent and environment and see if we cannot better optimize our daily experience.

This paper will advocate for daily empowered, adaptive decision making in the same manner pilots guide airplanes, as a healthy posture for human functioning consistent with the tenets of positive psychology. I believe this skill is the essential human process that optimizes performance and enables the flourishing and well-being so highly prized in positive psychology. We will also explore the concept of “situational awareness” or alert mental functioning and offer techniques and suggestions for developing and deploying this critical skill. I will explore how to create “pilot in command” self efficacy and maintain alert engagement or “situational awareness” rather than lapsing into mind wandering and disengagement. We will examine heuristic-based, “fast and frugal” (time and data limited) decision-making we use in aviation and apply this to everyday life for optimal performance for individual life and for organizations. All these techniques reside in the “executive functioning” of the brain. The FAA calls these HOTS or “higher order thinking skills”. We will briefly visit this area when we mention metacognition, the master skill for awareness.

How do people adapt and decide when the stakes are so high and the danger so apparent? What tools and techniques work reliably to guide success in a fast and frugal manner? Aviation is a laboratory within which to explore these questions, and we can apply what is learned in the aviation setting to everyday life. I often counsel my students with the metaphor of a football game. Careful plans are made in the huddle with visions of success and how the operation will occur. Once the ball is snapped, however,

everything changes, and fast, accurate, adaptive action is required for success. In aviation there are no “time-outs” so creating decision opportunities and remaining continuously alert and effective are essential. It also is a “long game” not a sprint and managing fatigue and developing grit and resilience are essential components.

Recently a student from a local university came into our school and while we were on the ramp looking at a small trainer aircraft and discussing the process, she asked how long it took to learn to “drive jets.” She did not merely want to pilot our little Cessnas we use in training but wanted to fly the sexy, sleek planes further out on the ramp. I told her it would probably take about 10 years since it required thousands of hours of experience and many FAA tests and certificates. She was incredulous and thought I was kidding. But to accomplish that process she would work very hard and begin to see and act differently in many diverse and exciting situations. Every action, thought and impulse would be retrained, tested and then iterated over thousands of experiences to become a successful jet pilot. This is truly a “long game” and a passion for the process is obviously essential. Just laying down a gold card will not get the job done. In life change also, growth is a long process with many steps and occasional plateaus and disappointments. I developed called “small smart victories”. Each step forward and upward is appropriately celebrated and becomes a building block habit or proficiency for further growth and progress. With this vision, each accomplishment becomes intrinsically rewarding, fulfilling and motivating. We define our goals and move forward toward mastery, at each step celebrating and enjoying the journey. Obviously our lives are not a dress rehearsal and the challenge of daily acuity is certainly the “real test”. The questions and challenges are always challenging and elusive. But with the

proper process, guidance and wisdom, we can apply our passion and achieve fulfillment and meaning in life. Let's engage, play hard and get in the game, 83% of coaches in elite sports rate "mental toughness" as the most important psychological characteristic for determining success (Gould, Hodge, Peterson, & Petlichkoff, 1987).

Positive Psychology

Positive psychology is the scientific study of human flourishing and optimization in individuals, organizations and our culture as a whole. It is especially important to distinguish their more classical Greek vision of "eudaemonic" wholesome fulfillment as life's intended goal from the typically modern, hedonic, pleasure-seeking "happiness". It is ironic that focusing on well-being and flourishing, positive psychology was actually born in the crucible of suffering and pain in 1965. Psychology in the mid 1960s was just emerging from a primary focus on behavioral cause and effect as the exclusive explanation for all animal behavior. For the previous 50 years all human actions and learning was explained by conditioning with no reference to internal cognitive causal explanations. The original "a ha" moment for the primary originator of positive psychology, Dr. Martin Seligman, occurred observing "learned helplessness" in dogs enduring electrical shock experiments. Though seeking to condition the dogs in the classical behaviorist manner, about a third of his experimental animals exhibited resilience and refused to give up even after all escape strategies proved ineffective. This seemingly inborn resilience and refusal to submit to failure contrasted starkly with another third of the dogs who totally resigned themselves to suffering and lay whimpering. Identifying and exploring this "learned helplessness" led Dr. Seligman's to examine these resilient animals and determine of the source of this amazing character

trait (Seligman, 2002). With the exception of various humanistic positive psychologists such as Abraham Maslow, psychology up to this point to a large degree on alleviating human pathologies and suffering. Seligman focused instead focused on determining the reasons for “learned optimism.” He explored and developed the techniques of flourishing in our harsh and “relentlessly indifferent universe” (Seligman, 1991, p. 111). A central and critical point to this whole paper is the basic tenet of positive psychology that we do not “find” or “discover” fulfillment and meaning in our world, we create it through our actions and wise creative life choices.

This original work of Martin Seligman was occurring at the time when the first cognitive psychology was just developing. In the 1960s Noam Chomsky wrote a devastating critique of B.F. Skinner’s Verbal Behavior, Jean Piaget’s theory of cognitive development was published and Ulric Neisser’s Cognitive Psychology became popular (Seligman, 2002). Martin Seligman, in collaboration with lab mate Steve Maier engineered a number of ingenious experiments that validated the learned response of the dogs and progressed to a cognitive explanation that became widely accepted: “learned helplessness” (Seligman, 1991) I have personally witnessed this behavior in pilots challenged with threatening emergency situations. Unfortunately, there still is a segment of the pilot population that when confronted with severe emergency operations, resigns and gives up. Usually, they have tried the obvious and formulaic solutions, but they progress no further...they just give up. The more positive resilient striving discovered and developed by Seligman, “learned optimism” became the basis for all the higher life skills studied in positive psychology. The decision-making analysis I will provide stresses the need for adaptive and creative decision strategies to combat

helplessness and assume positive control in emergency, high stress operations and in everyday life.

The discovery and development of Martin Seligman's learned helplessness and learned optimism research led directly to his theory of "explanatory styles". This was a revolutionary cognitive explanation for behavior that previously would have been explained entirely through conditioning. If a misfortune is mentally explained to oneself as permanent, pervasive and personal, a pessimistic worldview will develop: "I can't fix this, it is just me...I am cursed, and it will always happen, nothing I do matters!" Once a pessimistic explanatory style frames all future perceptions, it creates a negative world view and reinforces helplessness that can easily descend into a cycle of depression (Seligman, 1991). Cognitive therapy, developed by Aaron Beck at U Penn about this same time, was revolutionary method for transforming these negative thoughts and rebuilding damaged lives (Beck, 1979). In this therapy, a clinician can talk the patient out of their devastating negative cycle into a more optimistic world view: "This setback is universal, (it happens to everyone) temporary (it will pass) and unique (we can get beyond this one setback). Psychologist Carol Dweck has elaborated and expanded the idea of mindsets in her work at Stanford, (Dweck, 2006) supplying many replicated studies demonstrating the dramatic effects of explanatory style correlating positive mindset to future success and even good health and greater longevity (Dweck, 2006). An important point for the purposes of this paper is to emphasize that a person's effectiveness is a matter of life choices according to decisions we make and habits we develop throughout our lives. According to Dr. Seligman, a major determining factor in the course of our lives is whether we will engage and fight or cower and give-up. This

cognitive orientation is the essence of human achievement or failure and also the critical determiner of survival in high-stakes situations. An essential element of my thesis is a belief in human self efficacy and the effective agency of resilient human activity. If we are not genetically predisposed to optimism we can with effort tip the balance in this direction through commitment and hard work. Deci and Ryan's in their Self Determination Theory is a consistent and illuminating version of this same constellation of human strengths.

Dr. Seligman continued his research and elaborated his initial theories focusing on "learned optimism" through collaboration with like minded psychologists and developed these theories into robust and growing field of research we now understand to be "positive psychology". Instead of dwelling on the pathologies of depressive tendencies and helplessness which had occupied psychology for 50 years, Seligman focused on how to find, explore and develop the positive human emotions and achieve greater fulfillment in life. *Authentic Happiness* (1991) reflects his thinking at this time with the three pillars of positive emotions, traits and institutions. Seligman views the accumulation of positive experiences and emotions as "psychological capital" that buffer the unfortunate experiences we all encounter in life (Seligman, 1991). He further states positive emotion "may be the key to building resilience...they help people build their strengths and their virtues." (Seligman, 2002, p. xii). Elsewhere he says "the optimist has a massive defense against reality that maintains good cheer in the face of a relentlessly indifferent universe." (Seligman, 1991, p. 111). Clearly Seligman acknowledges the "existential dread" of a world devoid of meaning and does not view the world as a "bowl of cherries." For Seligman, life well lived is a creative, generative

process in which we do battle with the tools of positive psychology to achieve fulfillment and well-being. In *Positive Education* (2009) he clearly states that though our environmental bounty continues to improve and prosperity is increasingly the norm, depression continues to rise. There seems to be no correlation between material wealth supplied by our environment and human happiness and well-being; Easterbrook's "progress paradox" (Easterbrook, 2003). The environment does not supply fulfillment in itself, it's depends on how we creatively interact with our world and craft meaning through our personal and institutional decisions. (Seligman, Ernst, Gillham, Reivich, & Linkins, 2009). Our situation can even grow more complicated and untenable as options proliferate in our affluent society. As Barry Schwartz points out in *Paradox of Choice* (2006) ironically, "more is less" in a complex world of plenty (Schwartz & Sharpe, 2006).

The most recent evolution of Dr. Seligman's thoughts are found in *Flourish* with the PERMA model of positive psychology. The five pillars of a flourishing life are Positive emotions, Engagement, Positive relationships, Meaning and Achievement (or Accomplishment) (Seligman, 2011) In this book Seligman increasingly distances himself from the superficial goal of "happiness" as a shallow substitute for what humans are actually seeking in life. "Happiness" connotes "buoyant mood, merriment, good cheer and smiling" (Seligman, 2011, p.13) and does not capture and honor the fully human striving for comprehensive achievement and mastery in life. Perhaps the insipid, ubiquitous "smiley face" got to him but Seligman spurns modern "happiology" in *Flourish* and focuses instead on "well-being theory" as expressed in the five pillars of PERMA (Seligman, 2002). Especially important in this later work is the incorporation of success

and mastery...what humans truly seek in life according to Seligman. Again, it is very clear Seligman views life as a struggle and not a cheerful, innately happy place. Fulfillment is gained through achievement and active accomplishment. The third and highest form of happiness Seligman recently added to his model is the discovery and leveraging of our personal "signature strengths." Discovering and deploying these privileged domains in our lives creates fulfillment and meaning. Again, and very importantly, this is not "finding" meaning but "creating" this meaning. Eudaemonic fulfillment is a generative process working contrary forces of anomie and entropy (Seligman, 2011). Unfortunately, some positive psychology acolytes seem to dance gleefully through the world like we are in Willy Wonka's Chocolate Factory and everything we encounter must be a wonderful, tasty confection. This is a painful misreading of Seligman's work and both an ignorant and potentially dangerous view of the world we live in (Burkeman, 2013).

This paper focuses specifically at that origin level of positive psychology, examining the enigma of courage, decision making and self-efficacy. We will determine which perceptions and tools enable a person effectively function and prevail achieving a flourishing life rather than being rendered helpless. It's about taking charge, making effective decisions in life and creating positive change; how to "grab it and growl." In my opinion, this is the actual process of positive psychology; adaptive decision making. I will recommend emotional and cognitive tools to achieve the best (but not always perfect) outcome. I believe that self-efficacy, human agency and resilience are the root competencies for all of the higher level PERMA attributes that now define positive psychology. Interestingly, with the exception of "explanatory style" much of this basic

mental machinery is not explored directly by Dr. Seligman or the central researchers in positive psychology. It's almost as if we need to develop this "missing manual" for success and flourishing in life. I will seek to expand this area of study with analogies from my career in aviation and pilot education. We will explore creative, adaptive decision-making, situational awareness, executive function, and metacognition as necessary tools for achieving well-being and fulfillment. The last section and conclusion will be the "missing manual" for piloting your life toward fulfillment.

The Battleground: Your life, Your mind, your wallet!

Researchers estimate we make over 10,000 decisions as we navigate the course of just one day (Hertz, 2013). In her book *Eyes Wide Open: How to Make Smart Decisions in a Confusing World*, Noreena Hertz (2013) recommends empowered decision making, choosing our own path as efficacious agents. "Eyes wide open" is certainly the necessary psychological posture for creating a positive existence directed toward meaning and fulfillment. Leveraging our own personal signature strengths has been shown to enhance our eudaimonic satisfaction and create meaning and fulfillment in our lives. As we already noted most of us are not actively piloting our lives but can often be mind wandering or disengaged at work, but the story get worse when you consider the forces persuasion in our society aligned to influence our lives. Many psychologists and neuroscientists are not only working to improve and enhance our lives, they are employing psychological research to market and control our brains and life choices. According to Gerald Zaltman, Joseph C. Wilson Professor of Business Administration, at Harvard estimates 95% of our decisions are in made unconsciously (Zaltman, 2003). Our modern lives are filled with data deluge, distraction and

uncertainty as “neuromarketers” cleverly access our neurological landscape, controlling our behavior through advertising. If we do not want to be victims of a future that others dictate, we better step up, take charge and become empowered decision makers. The ball has been snapped, the games in play let’s get tough.

The necessary “psychological posture” for successful piloting is called “pilot in command” (PIC) which means both assuming the age old “captain of the ship” authority but also an ability and willingness to constantly assess, evaluate and take charge in all flight and ground operations. Additionally, a safe pilot has “situational awareness” or constant accurate and alert knowledge of all elements of the flight environment. In my job as an FAA Master Flight Instructor and FAA Designated Pilot Examiner, these are some of the critical skills we must discover, create, elaborate and test in every successful pilot candidate we educate. This PIC attribute by necessity requires extreme self-efficacy as well as “fast and frugal” (limited time and data) decision making. In the time-critical, high-stakes environment of aviation, we most typically do not have the luxury of all the information, sufficient time or mental computational power to arrive at optimal conclusions after extensive deliberation. We must observe, orient, decide and act decisively. This skill is teachable and a critical tool for assuming control of our everyday lives in a sea of negative influences.

To fully appreciate the amazing toolkit of pilots and aviation, consider the situation of US Airways Flight 1549 with Captain Sullenberger and first officer Jeff Skyles when their jet full of passengers hit a flock of geese that suddenly destroyed both of their engines and made them a glider 3,000 feet over New York City. A “normal day” suddenly demanded immediate and decisive action. The situation was not covered

in any previous training or checklist if there even were time to consult one. In only 208 seconds they were successfully floating in the Hudson River with all souls on board alive and well. But “The miracle on the Hudson” was actually nothing miraculous. There was no divine intervention here. This was amazing correct, accurate and decisive decision-making by a professional, highly-trained flight crew working as a team both internally and with resources on the ground. Helplessness and giving up was not an option for a professional pilot crew, they continued to work the problem to reach an acceptable outcome despite seemingly insurmountable odds. Another example among many is the “Gimli Glider” incident on July 1983 over central Canada when a Boeing 767 ran out of fuel at 41,000 feet. The crew acted decisively and efficiently (based on available information and limited time) and despite no power and limited flight controls, they successfully glided the 200 ton Boeing airliner and landed successfully with no injuries on a closed airport with no ground control assistance available. This jet flew out under its own power after minor repairs only two days later. A last example of courage, resilience, PIC authority and also exceptional teamwork was the Sioux City DC-10 crash of United 232 in July 1989. Despite losing all flight controls due to a catastrophic engine failure at 37,000 feet over the Midwest, the pilots continued to struggle despite insurmountable odds and successfully make it to an airport at Sioux City where crash vehicles were prepared and save 111 lives. They managed to turn and control the plane by applying differential thrust on the two surviving engines, a procedure no one had previously even considered possible. They invented a survival tool not found in any manual, and never successfully replicated later in subsequent simulator attempt. They clearly should have all died except for amazing courage, resilience and self-efficacy on

the part of the crew. All three of these emergency situations required super-human self-efficacy and skill to realize a superior outcome. Giving up is not an option and time constraints require “fast and frugal” decisions and continuously adapting procedures. I have included one personal emergency situation I survived in Appendix 1. All of these cases are examples of decisive empowered decisions made in critical situations. They required fast and frugal heuristic based decisions due to the time-critical environment. These same survival skills can be leveraged for greater well being and flourishing in our daily lives by determining and creatively deploying our signature strengths. Piloting our lives willfully is necessary to achieve meaning and fulfillment. The other option is passively accepting an existence dictated by our genetic predisposition, our society or worse the hedonically driven need for continuous consumption injected into our brains by “neuromarketers.”

Another founder of the discipline of positive psychology who advocates strongly for effective human agency in the face of external pressures is Mihály Csíkszentmihályi authentic human existence as continuously combating “psychic entropy” in our daily lives, overcoming the “treadmill of social controls” and also the “submission to genetic programming.” According to Csíkszentmihályi we need to “...transform the random, crushing forces of the universe into manageable, or at least understandable, patterns” and ultimately “reclaim our experience.” (Csíkszentmihályi, 1991, p. 11). The highest human experience is to reclaim our consciousness from these forces and achieve the optimal human experience of flow. We are talking “positive psychology super hero” now! A wonderfully powerful writer, Csíkszentmihályi strongly castigates “the pervasive listlessness that affects so many lives...As long as we obey the socially conditioned

stimulus-response patterns that exploit our biological inclinations, we are controlled from the outside” (Csíkszentmihályi, 1991, p.19) I guess I can rest my case on the need to take charge of our lives and develop PIC authority after that strong exhortation. Expert performances are typically totally in this totally absorbed flow state. This mental state simultaneously requires and allows complete focus, leveraging our personal signature strengths. Obviously we are not going to access this amazing experience if we are mind-wandering, it takes and effort of will as well as active engagement and passion. Next we will explore some historic decision models from respected psychologists, the attributes of resilience and then recommend conscious decision making techniques in our lives to achieve this creative, fulfilling life based on the tenets of positive psychology.

Outline of Decision Models

Dr. Herbert Simon won numerous academic awards as a gifted and diverse thinker in the 1950s through the 1970s primarily working at Carnegie Mellon University. He was an early computer scientist researching in artificial intelligence as well as a political scientist, economist, sociologist, and psychologist. Clearly a global thinker dabbling in many fields from philosophy to public policy, he won his Nobel Prize in 1978 for his pioneering research into the decision-making process. Simon was one of the first to explore and develop cognitive psychology and escape the behavioral mindset that held psychology captive for almost 50 years. He coined the terms “bounded rationality” and “satisficing” (making a “good enough decision” with “just enough” information) which we shall explore fully here. He published almost a thousand highly cited publications (Simon, 1965).

The short summary of Simon's relevance to this paper is his theory of "bounded rationality" (Simon, 1965). Human decision makers are limited in time, information and processing power when confronted with choices in the real world. Rather than striving to achieve the optimal result in every situation, we need to achieve a satisfactory result and move on. Gerd Gigerenzer, the director of the Center for Adaptive Behavior and Cognition at the Max Planck Institute for Human Development, developed Simon's thinking further and calls this "fast and frugal" decision making (Gigerenzer, 2008). His work largely focuses on heuristics (roughly "rules of thumb") in place of extensive rational processing. He defends heuristics as efficient tools essential to all decisions in our modern, rapidly changing environment. Following Simon's lead, Gigerenzer maintains that if we do not limit our search for data we encounter "paralysis by analysis" waste time and miss opportunities. Herbert Simon coined the term "bounded rationality" to indicate the necessity and efficiency of limiting our search and time on task to an efficient compromise of "good enough."

Other researchers central to exploring this decision model are Gary Klein and William Duggan both at Columbia. Both of these researchers stress the need to evolve beyond the limitations of Roger Sperry's now superseded "dual mind paradigm." This view of our separate rational and intuitive, right brain left brain, won Sperry a Nobel in 1970 and has become a pervasive cultural meme. A popular modern proponent of the dual processor is Daniel Kahneman who separates our mental processes into an intuitive parallel processing "System One and a careful rational (but seldom invoked) "System Two." Kahneman characterizes humans as "predictably irrational" with their defective decision making (Kahneman, 2011). This leaves humans ineffective and

hopelessly dependent upon superior and sapient “others,” supposedly higher authorities for decision accuracy and agency. How would humans have evolved so successfully through time if we were so defective and dependent by nature. Perhaps being “irrational” is our saving grace? Both Duggan and Klein advocate for a greater unitary intelligence transcending the duality of analytic/intuitive and based on modern cognitive science. Klein and Duggan espouse a unitary decision making strategy with rich examples from successful decision-making experts from Napoleon to Captain Sullenberger.

Eric Kandel, who won his Nobel in 2000 for neurological analysis of brain function and the exploration of ‘intelligent mosaic memory’ (Duggan, 2013). Kandel modeled a unitary whole brain intelligence that utilizes both intuition and rational analysis accessing the whole brain as a unit. Klein and Duggan emphasize the integration of the intuitive and analytic processes to achieve the most efficient solutions to daily decision challenges (Duggan, 2013). Duggan goes further to define three types of intuition and especially focus on “strategic intuition” (Duggan, 2013). Duggan calls this the “executive mind” and uses examples from military history, specifically the work of Carl von Clausewitz to illustrate how highly successful Generals like Napoleon employed strategic intuition to great effect.

A seemingly inexhaustible researcher, Gary Klein utilizes an ingenious, real-world process to analyze successful decision-makers such as firefighters, pilots and military personnel in high-stakes environments. He calls this method “naturalistic decision analysis” (Klein, 1999) to distinguish his real life focus from the artificial laboratory decision research. Using cognitive task analysis he teases out the mental

processes that have proved successful in many amazing real world crisis situations. My thesis is that we can leverage these adaptive decision-making tools in our daily lives to make decisions and life choices less stressful, more efficient and achieve greater well-being and fulfillment...our PERMA goal. Tested in the heat of battle these techniques apply to the kitchen counter as well.

An example of a battle-tested paradigm that translates into everyday decision making is Colonel John Boyd's O-O-D-A decision model now taught in every business school in America. His work will be the basis for our final recommendations and conclusions. Arguably the greatest fighter pilot in American history but also one of the least known military theorists, Boyd was the commander of the Top Gun school at Nellis Air Force Base for 10 years. He later went to the Pentagon, created the F-16 fighter jet and developed the "Observe-Orient-Decide-Act decision model" (Coram, 2002) for iterating effective actions in air combat maneuvering and rapidly changing environments. His O-O-D-A system was the strategy for America's First Gulf War and came directly from his experience in supersonic dogfights. This framework applies perfectly to our complex and changeable daily lifestyles and became the model for the FAA "3P; Perceive-Process-Perform" aeronautical decision framework. Boyd repeatedly cited Carl von Clausewitz who is also a primary resource for William Duggan's "strategic intuition".

A refreshing and wonderful characteristic of strategic intuition and heuristics for decision making is their elegance and simplicity. In a world of increasing complexity, time compression and stress, the simple elegant solution is a ninja move that slices the Gordian knot. Too often with rational analysis we create even more complexity seeking

solutions. Intuitive, flexible and adaptive decisions are generally “simple rules that can outperform the more analytically complicated and information intensive approaches” (Eisenhart & Sull, 2015)

Please forgive one additional related observation before we delve further into this exciting topic. As a pilot of many years and aviation educator and evaluator, I have been always interested and confused why perfectionists are so seldom successful in complex, high-stakes environments. They function very well in predictable, stable situations but fail miserably when the challenges are complex and variable. I think secretly, I always wished I was that “perfect person” who could achieve such a level of precision. Personally I always fell short and more accurately characterize myself as a “hacker.” But increasingly I have noticed over many hours of experience, the “hacker” mindset is actually the successful player in complex, highly changeable environments. The perfectionist encounters the fluidity and messiness of the real world and often falls into confusion and helplessness. The “hacker” with the MacGyver vision and ingenuity is always the more successful player when the challenges are dynamic and fast-paced. Recent researchers such as Brené Brown; *Gifts of Imperfection; Let Go of Who You Think You’re Supposed to Be and Embrace Who You Are* (2010), explain this enigma well and will be part of our later discussion. Let’s dive in and get our hands dirty.

Simon’s “Satisficing” and “Bounded Rationality”

Herbert Simon won his Nobel Prize was debunking the pervasive, historic theory he called “Economic Man.” In his seminal paper “Behavioral Theory of Rational Choice” (1955) Simon developed and explained a more realistic view of human capability and decision making. In BTRC he debunked the historic “Economic Man” theory that

presupposed an omniscient, hugely powerful rational thinker that was the accepted view since the time of Francis Bacon. In his “Rational Choice and the Structure of the Environment” (1956) Simon explored the environment the organism interacted with and further refined his criticism of human capability presupposing infinite, time, knowledge, perceptual and computing power (Simon, 1956). Simon postulated instead the “Administrative Man” that typically “satisfices” rather than “optimizes” in his daily decisions. This modern, time-limited administrator can freely decide using heuristics without seeing all available information. “Because administrators “satisfice” rather than maximize...they can make their decisions with relatively simple rules of thumb.” (p119, Simon, 1965) Simon developed this phrase “satisficing” by combining “satisfy” with “suffice” to describe how individuals must seek the “good enough” in most situations rather than an “optimal” answer or item. The human mind, by necessity, restricts itself by imposing boundaries or “cognitive limits” he called “bounded rationality” and when interacting with the environment applies “ecological rationality” (Simon, 1955). We are usually limited in time, information or the processing power and cannot achieve the “optimal” if one even could be said to exist in a changing environment. Humans must “satisfice” for efficiency and survival. Simple rules are the use of heuristics or rules of thumb. This neurologically necessitated “fall from human perfection” of “maximizing” has psychological as well as physical ramifications we will now explore.

In “Rational Choice and the Structure of the Environment” Herbert Simon draws from his work in Artificial Intelligence and his work with the complexity of the decision-making process to postulate the interaction of the agent and the environment in an interactive relationship during all decisions. Simon describes the brain and the

environment as two blades of a scissors. One blade is “cognitive limitations” and the other is “structure of the environment.” Either blade will only work when played against each other (Simon, 1955). He adamantly opposed the tendency to overanalyze and complicate mental processes. Most often complexity observed is the result of environmental interaction with mental processes that are internally simple and elegant. His famous “Ant on the Beach” metaphor clearly argued that an observed outwardly highly complex behavior, such as the wandering path of an ant returning to its nest, is really the result of only a few simple internal rules interacting with a complex environment. The interaction with the environment is what creates the apparent complexity. Recent scientific research has corroborated Simon’s early theorizing. His discovery of “simple rules” has proved to be the elegant answer to historically intractable questions. The fantastically complex murmurations of starlings and the schooling behavior of fish have perplexed observers since the ancient Greeks. Modern scientists have exhausted complex computer models attempting to solve these problems often running out of available memory. A recent ingenious discovery by Craig Reynolds with his C++ computer program “boids” reveals that only three simple rules completely explain this amazingly complex behavior; an intuitive ninja move! “...avoid collisions with nearby flockmates...attempt to match velocity with nearby flockmates...attempt to stay close to nearby flockmates” (Reynolds, 1985). Observed complexity is a trap that ensnares many researchers in psychology and thinkers in philosophy necessitating a search for a complex motivation or “inner explanation.” In many cases the inner motivating cause is simple. What we perceive in daily life as complex always combines the agent and the environment in a dynamic interaction.

“Simple Rules” by Donald Sull and Kathleen Eisenhardt is a comprehensive study and fascinating explanation of this interesting phenomenon.

Barry Schwartz in his book “The Paradox of Choice: Why More is Less” beautifully expands and explains the human decision dilemma and why compromise in life is both a necessary and desirable course of action. Unfortunately most people fail to “get it.” They fail to understand or graciously accept our psychological and physiological processing limitations. “Satisficing” is both necessary, and given our limitations of time, information and processing power, desirable. To continually strive for “the optimal” is setting ourselves up for failure and the associated emotional disappointment. This is an obvious recipe for dissatisfaction in life. As in almost everything, the Greeks documented this chronic human failing with the myth of Sisyphus where our stone rolls back down the hill on a regular basis. This paper will largely be an attempt to explain and develop the “satisficing” option especially in complex, dynamic circumstances. Especially in an environment that involves a great deal of uncertainty and make severe demands on our attention, “fast and frugal” (heuristic based) decision making is essential. Viewed and applied correctly, “satisficing” and heuristic based decision making can be more efficient and effective and also a path to fulfillment and flourishing.

Daniel Kahneman

Another respected researcher and author who has thoroughly examined the human decision dilemma is Daniel Kahneman, in his book *Thinking Fast and Slow* (2011). He earned a Nobel Prize for his work in biases and prospect theory demonstrating the “predictably irrational” human failings in decision making. Especially when it comes to immediate, intuitive choices in the quantified arena we are fooled

through our biases and errors in cognitive framing. Previous to Kahneman's research and published work, it was still widely believed that human choice was fairly rational and reasonably accurate. Kahneman's research proves the truth of Simon's assertion that we are limited in processor power especially for certain statistical functions. His prospect theory has been widely accepted and applied. A central weakness of availability involves putting too much emphasis on what is right in front of us (WYSIATI; what you see is all there is) We continually ignore what is out of sight and unavailable (Kahneman, 2008). This is an important consideration to remember when making decisions in your life. Unfortunately, Kahneman expands this deficient human ability in the statistical arena to include all human decision making and we are left with a fairly pathetic vision of human agency; "we often need help to make more accurate judgments and better decisions...policies and institutions can provide that help" (p. 411, Kahneman). He contrasts his views with the Chicago school of economics with its faith in human rationality, expressed in Milton Friedman's *Free to Choose* (1990) Kahneman argues against the libertarian view and analyzes the "choice architecture" in detail (Kahneman, 2008).

Kahneman follows earlier work by psychologists positing a "dual-process framework" that includes one intuitive, automatic, heuristic based system and one analytic, rule-based and computationally expensive system (Kokis, Macpherson, Toplak, West, & Stanovich, 2002). Labeled System 1 and 2 by Stanovich and West (2000), these two generic modes of cognitive function each have unique functions, strengths and weaknesses. Kahneman is here following a well-developed line of thought, but he is the most prominent author to bring this work to public view. (See

Appendix 2 for a complete listing of the research here) The automatic “System 1” with “innate skills that we share with other animals.” This system “operates automatically and quickly with little or no effort and no sense of voluntary control.” (Kahneman, 2011, p. 20) This view of Kahneman is in the tradition of Paul Meehl, of the “heuristics and biases” school of thought. System 1 is intuitive and rapid utilizing heuristics which are fast and dirty decision tools that are often in error (Meehl, 1954). System 2” is the thoughtful, rational mode of thought but computationally expensive hence slower and also “lazy” about getting involved. “The operations of System 1 are fast, automatic, effortless, associative, and difficult to control or modify. The operations of System 2 are slower, serial, effortful, and deliberately controlled; they are also relatively flexible and potentially rule-governed.” (Kahneman, 2011) These two systems share an uneasy balance in decision making. The innate/intuitive system 1 is fast and parallel processing carrying out the bulk of our daily operations, by some estimate 95% (Hertz, 2013) Unfortunately System 1 is often too rushed and subject to many errors of bias, habit and stereotype. System 2 though rational is unfortunately limited to the corrupted data from the System 1 perceptual system as well as limited capacity. Very important to our argument here, Kahneman views system one, heuristics, as completely intuitive and ungoverned, automatic and hence often misapplied and in error. Kahneman’s major contribution was illuminating the discrepancies between this intuitive knowledge and analytical knowledge. His work in *Thinking Fast and Slow* (2008) primarily focuses on “statistical intuition.” Even statistical experts choose poorly intuitively even though they analytically “know better” much like the familiar visual illusions, you cannot seem to help yourself. In summary, Kahneman’s view of human decision making ability at least on the

statistical level, is depressing. If Herbert Simon debunked the original Baconian omniscient “Economic Man” decision maker, Kahneman threw him all the way under the bus.

Gerd Gigerenzer

A prolific researcher from Berlin who defends the necessity and efficiency of the fast processor heuristic system is Gerd Gigerenzer. He is the director of the Center for Adaptive Behavior and Cognition at the Max Planck Institute for Human Development. He has written numerous articles and books explaining and promoting both the value and necessity of heuristic decision making e.g. *Simple Heuristics That Make Us Smart*(1999). His book *Bounded Rationality: The Adaptive Toolbox* (2002) is an edited collection of articles that resulted from a symposium of thinkers dedicated entirely to heuristics. According to Gigerenzer, humans use these mental shortcuts to great advantage everyday and they provide superior results. The true intellectual heir to Herbert Simon’s “satisficing,” Gigerenzer has expanded the study of “bounded rationality” and far from bemoaning the limitations, he claims clearly that less information in decision making is often a stronger position and a better result. Waiting for all the information can both delay the result *and* yield an inferior product. The key in Gigerenzer’s model is limiting the information search to just enough information a process he calls “rational ecology.” Expert decision-makers search less and use less information than novices. (Gigerenzer, 2014) This was derived and developed directly from the work of Herbert Simon, especially the work in artificial intelligence. simple rules and the precise requirements to limit search.

One of Gigerenzer's common examples of the efficiency of heuristics in everyday life is the "gaze heuristic" which allows an outfielder or soccer player to run and catch a ball in flight. If you asked the player how they successfully accomplished this feat, they would probably be at a loss. Analysis of the phenomenon leads to a very simple solution. The player runs in a direction and at a rate to maintain a constant gaze angle to the horizon of the ball in flight. With this technique, they will end up at the same place at the same time as the ball and successfully complete the play. A pilot in a glide maneuvering a powerless plane uses this same gaze heuristic to gauge and adjust the flight to obtain a precise landing spot (as in the Sullenberger example). Whatever is exhibiting no relative motion in the field of view, at a constant airspeed, will be the location of landing. If we analyzed all the precise physics of either of these operations, the mathematics would easily exceed what we could accomplish with even a powerful computer. The vector analysis and wind variables would be an immense data set and the analysis would clearly exceed the human level processing power (especially in an emergency). But with an appropriate heuristic rule of thumb we can repeatedly achieve success (even without consciously understanding or stating the process). This is the "fast and frugal" decision making framework. When we are faced with an urgent situation without the luxury of unlimited time or information, a heuristic, rule of thumb is the tool of choice. This standard of execution is a common currency in daily activities. Many in the military call this "TLAR" or that "looks about right" when there is no time to engage in careful analysis. Computer programmers often refer to such extemporaneous solutions a "hack." The critical questions are the functional limits of any heuristic or rapid prototyping system and how much we can consciously "reprogram" the contents and

strategies. Kahneman depicts heuristics as fast and dirty, often in error and “innate” shared with lower organisms. Gigerenzer promotes the efficiency and necessity of heuristics. He readily admits they must be applied appropriately and advocates for an “adaptive toolbox” of heuristics. Also according to Gigerenzer we can consciously access, modify and tweak the heuristic vocabulary to accurately mirror and function with a changing environment. Before we analyze the nature of heuristics further let's explore the decision process in action.

Gary Klein

Gary Klein is probably the most highly regarded researcher in the field of decision-making in the high-stakes, time-critical environments. Instead of setting up laboratory experiments with choice matrixes, Klein studies how expert decision makers like fire fighters, soldiers and pilots execute their skill by interviewing them after the fact with cognitive task analysis. This technique has become called Naturalistic Decision Making to distinguish his real-world techniques from the sterile laboratory analysis. In his interviews, Klein discovered that heuristics are highly effective and almost universally applied in time-critical high-stakes situations by expert practitioners. People in critical, demanding emergency situations do not apply rational analysis to solve problems or select from a handful of choices. They react almost immediately using intuition to access a rich almanac of previous experience immediately discovering the best solution. This is so much the case that Klein often has a hard time eliciting the actual mechanics of a particular decision process. Many experts in an after action report indicate there was “no decision” or it “was automatic” or even “ESP” since the decision was so “intuitive” or automatic as to be transparent to the operator. An important factor

here though is the prerequisite of expert level performance with years of experiences. The practitioners interviewed often said they *did not decide* but immediately knew what to do. Obviously they were relying on an extensive bank of implicit knowledge or experience that was available and triggered in the emergency situation. This “expert intuition” is the triggering of implicit or hidden expertise by various environmental cues. We shall examine the interplay of environmental cues and implicit vs explicit knowledge later in this paper. This environmental complexity and cueing may be the critical determinant of success or failure in high-stakes, time-critical decisions.

So you can see a very different world view between Daniel Kahneman and Gigerenzer or Klein. For Kahneman the automatic fast processor is the primary decision-maker and accurate and dependable only for predictable, everyday situations. In rapidly changing, complex environments the “pattern matching” for Kahneman is frequently a source of bias and errors. In the views of both Gigerenzer and Klein, the rapidly changing environment *necessitates* the use of heuristics because they are faster (and Gigerenzer would say superior) job. Slow methodical rational analysis would stall and induce “paralysis by analysis”. The implicitly available almanac of adaptive behaviors and experiences is a rich resource to Klein and Gigerenzer and for both these theorists, less information is a better framework, bounded rationality, yielding more accuracy in decisions. Accessing a bank of expert experience that is “on the shelf” and ready to apply to a variety of situations is not well represented in Kahneman’s views. He sometimes depicts the System 1 rapid intuitive processor as “innate” and sometimes as “not readily educable” (Kahneman, 2008). In either case it is not a privileged domain of operation in his view. In all these systems, the question arises as to the fate of a

beginner in a high-stakes, time critical environment. It seems unlikely they would react correctly in this “automatic mode” without the benefit of expert experience.

Between these polar extremes of Kahneman’s “predictably irrational” which has been called the “rational pessimists” and the limited human processor “apologists” who advocate for heuristics are a whole spectrum of researchers with varying degrees of confidence in the human ability to rationally navigate decisions. In the center is Keith Stanovich, at the University of Toronto. He is a “meliorist” who has done extensive research on a human’s capacity to overwrite the intuitive reaction and believes a learned response is possible to gain self-knowledge of areas we should not guess about. His book *Who is Rational* (1999) is a dense but fascinating analysis of this landscape.

Interestingly, despite their obvious differences, Gary Klein and Daniel Kahneman decided to attempt a collaboration on exactly this question. This was a handshake across a considerable intellectual divide. As Kahneman describes their affections: “Gary Klein, the intellectual leader of an association of scholars and practitioners who do not like the kind of work I do” (Kahneman, 2011) This was an “academic tug of war” between the heuristics and biases camp of Kahneman and Klein’s Naturalistic Decision Makers viewpoint. Unfortunately the article “Conditions for Intuitive Expertise” (Kahneman & Klein, 2009) did not surface any remarkable breakthrough agreements. Two interesting points on which both schools of thought agreed though: the quality of the environment in which decision making occurs is critical to whether expertise will be effective and learning will be enhanced. High-validity environments where cues, effects and actions are reliably linked to results leads to effective learning (as opposed to

capricious, spontaneous events). Also predictable environments lead to learning as opposed to situations where you might “get lucky” and erroneously interpret this as successful execution. Another observation about the study was the overall negative bias of the Kahneman approach, focusing more on avoiding errors whereas the Klein worldview was built upon studying expert performance and building expertise. Both participants should be congratulated for professionally engaging in a collaborative effort but unfortunately not much common ground was discovered.

The interesting essence of all these theories for me is the question of how accurate our interpretation of reality might be either from the intuitive System 1 or the rational System 2. Can we accurately map “reality” either rationally or intuitively? Indeed as David Cooperrider counsels for positive change, “words create worlds.” This can shift the terrain of perception in many directions. Additionally can we predict or decide an effective course of future action? Perhaps our perceptions and frames are so skewed they only present reality as we want to see it? Are other players essential to accuracy?

William Duggan Strategic Intuition

William Duggan’s point of departure for his book *Strategic Intuition; The Creative Spark of Human Achievement* (2013), is the common experience we have of getting our best ideas or breakthrough revelations. As related by personal experience or recounted through history, these breakthroughs most commonly occur not at work but in the shower, walking or relaxing. Unplanned, they arrive by surprise at some random, and usually non-stressful time. Typically the mind, though prepared and primed associatively, is currently mostly ostensibly at rest and unburdened. Miraculously the mental pieces transform, the light comes on, the picture comes into focus and the hard

work we have done suddenly reveals a new idea. Duggan distinguishes this “a-ha” moment from the “blink” experience of Malcom Gladwell or flash of recognition of Gary Klein. According to Duggan these represent “expert intuition” which rely entirely on reassembling past experiences. These are the snap judgments where we immediately recognize something familiar in a new context or setting and apply this insight in immediate action.

Characteristically strategic intuition is slow to generate, more like a word you are searching for in memory. It arrives after effort and struggle uninvited in an unexpected flash. These precious ideas are highly sought by business and the arts but resist exotic formulas to elicit their creation. Despite the expensive efforts to engender creative inspiration through brainstorming or various bonding or retreat sessions, “strategic insight” often strikes in the shower, caught in traffic or when the mind is finally freed from burdensome calculations or quotidian concerns. Strategic intuition can’t be called or created, only engendered through careful priming of associative data. Strategic intuition is a flash of immediate understanding that occurs on it’s own schedule.

Duggan draws extensively from Carl von Clausewitz, a military theorist from the 19th century. According to von Clausewitz there are four stages involved in strategic intuition. First, you must stock your brain with various “examples from history” (Duggan, 2013). This hard work and study puts “data on the shelf” and provides the raw materials in the correct accessible mental playground. Step two requires freeing the mind from attachments and preconceptions, remaining aware but free of judgment. Once the groundwork laid, we await the flash of insight which von Clausewitz called coup d’oeil, which is French for “glance” (Duggan, 2013). Examples through history are legend and

the context is always amusing and surprising. The fourth and final step once this miraculous flash occurs, is committing to action, energetically embracing and empowering the change. Of all these actions, the second step, freeing the mind, is the most difficult but also most critical to success. This involves not pushing the idea or guiding it in any way but patiently establishing a zone of calm acceptance and peace. The eastern philosophical tradition often refers to this state as “beginner’s mind” or an openness to any option or occurrence without judgment.

Duggan reviews and dismisses many standard industry techniques for eliciting strategic insight. Most run directly counter to the basic elements of the four step procedure. Rather than unstructured free time which is most commonly applied in several forms, Duggan recommends associative priming with known categories and actions in row and column format. Then spend time rearranging them dispassionately and creatively until the insight occurs. Rather than creating a void, you are marinating in the problem pieces then backing off just a bit when the picture suddenly comes into focus. Duggan gives examples from Napoleon to Patton, Bill Gates and Google to illustrate strategic intuition.

The amazing innovation in Duggan’s vision is that strategic intuition erases the dividing line between the analytic/rational and the intuitive mode of thought. Either rational or intuitive or combination may surface with strategic intuition. Interestingly, researchers like Paul Smolensky at John’s Hopkins University are working on a “unified grammar” and programming computers for greater efficiency with both rule-based interpreter and an associative neural net processor. Simple serial rule interpreters are computationally intensive and slow. Associative neural networks are lateral, parallel

processors that simulate intuition. The frontiers of computational artificial intelligence are exploring these areas to create “human-like” lateral processing computers like the latest version of Deep Blue. A radical version of this is *The Harmonic Mind* by Smolensky and Legrendre: “Despite their apparently divergent accounts of higher cognition, cognitive theories based on neural computation and those employing symbolic computation can in fact strengthen one another” (2006). These are called “connectionist theories” in psychology and computer science and blend “hard rules” of rationality with “soft constraints” of intuition. The results are productive and exciting.

Col. John Boyd: Observe-Orient-Decide-Act (O-O-D-A)

Col. John Boyd is one of the most under-appreciated theorists of the 20th century. He was an Air Force fighter pilot and later a Pentagon military strategist but not well known by name outside this small world. He was a creative but hard-nosed iconoclast who threatened the comfortable order at the pentagon and cared little for promotion and fame. Outside the military, his anonymity is largely due to his firm conviction that anything published will be go from doctrine to dogma and become instantly an impediment to development and adaptive, creative growth. He gave oral presentations, usually Pentagon briefings, that were legendarily lengthy (14 hours) and intense. He refused to even draw a conceptual diagram of his Observe-Orient-Decide-Act decision process lest it limit imaginative recreation. As a consequence there is no published record of his work though the slides from his briefings survive. One collaborator, Chet Richards, has been largely responsible for saving and promoting Boyd’s work. His book *Certain to Win* (2002) elaborated Boyd’s theories and applied them to the competitive world of business. Despite his aggressive anonymity, Boyd’s theories became the basis

for the Marine Corp's total reconfiguration into "Maneuver Warfare." His planning strategies were the basis for the both of the original Gulf Wars. During the early 1960s, Boyd and mathematician Thomas Christie created the famous E-M energy-maneuverability formulas for aerial combat that became the standard for all military aircraft design. General Stanley McChrystal's flat military structure, described in *Team of Teams, New Rules of Engagement in a Complex World*, that completely transformed JSOC and the current war in Afghanistan is an application of Boyd's flat empowered decision-making strategy. McChrystal's fully engaged, self-organized, multifunctional teams operating with fast feedback iterative cycles is classic Boyd theory in action. John Boyd's theories also are the basis for "agile development" that reshaped the software industry and how teams function and deliver their products in fast iterative sprints and scrum cycles (Harvie & Agah, 2014) .

Boyd's O-O-D-A decision model is aggressive and combative in nature due it's origin in aerial warfare but the paradigm is easily applicable to a number of competitive daily environments and amazingly consistent with the tenets of positive psychology. His objective in life is: "To flourish and grow in the many-sided uncertain, and ever-changing world that surrounds us suggests that we must make intuitive within ourselves those many practices we need to meet the exigencies of that world" (Coram, 2002). In format, the decision framework created by fighter pilot John Boyd is very similar to Duggan's four step procedure and both draw heavily from the theories of Carl von Clausewitz. One significant difference is Duggan's use of the essential pause for "beginner mind" of expectant delay between the observe-orient and the decide-act. This is where "strategic intuition" and wisdom flow into Duggan's world view. The lack of a pause would be

understandable given Boyd's usual activity might be occurring at Mach 2 in an F-16. Critical to an understanding of Boyd is his assertion that uncertainty and continual change is a fundamental and irresolvable characteristic of our lives. Secondly, managing and directing time and energy is critical to success and achievement. Though John Boyd greatly valued creativity and ingenuity it all occurred in the crucible of intense and time-limited recreation.

A flourishing life is achieved by creatively and continuously engaging and interacting with our environment: Observe-Orient. This develops what a pilot or military officer calls "situational awareness" (Endsley, 1995). Once an accurate and comprehensive SA is acquired, the active agent creates a strategy based on mission objectives; Decide-Act. This activity is looped back into another iteration of the full cycle to control and direct time. This is empowered decision making.

The emphasis for Boyd was rapid and repeated cycles of creative iteration based on adapting to uncertain, ever changing, unpredictable conditions in the world. The critical parameter in Boyd's work is the frequent reexamination and reevaluation of what we are doing and where we are heading: continuous re-goaling. We must employ and operate in our protean world by having flexibility in our goals. A system for adaptive decision making in time-critical, high stakes environments was the crucial result. His model was designed for air combat but it is also clearly applicable to any kind of competitive environments like business, politics, and sports. A classic Harvard Business Review article from 1988, "Fast Cycle Capability for Competitive Advantage" (Bower&Hout, 1988) features Boyd's decision model applied to business.

Traditional ideas of “good management” with vertical pyramid structures and clear fixed objectives look like Simon’s “Economic Man.” These have given way to fast-cycle innovation in our rapidly-changing business world. Boyd’s theories resemble the adaptive heuristics of Simon’s “Administrative Man”. Keith Hammond, director of the Center for Strategy and Technology at the Air War College, covered Boyd in his Leadership series in Fast Company; “The Strategy of a Fighter Pilot.” Boyd’s loop is a simple reckoning of how human beings make tactical decisions. But it’s also an elegant framework for creating competitive advantage...The concept is just as powerful when applied to business or life. The convergence of rapidly globalizing competition, real-time communication, and smarter information technology has led to a reinvention of the meaning and practice of strategy” Is your business an F-16 or an Aeroflot turboprop? (Hammond, 2002). Historically, business has learned a lot from military strategy and Boyd is one of the seminal contributors. We must constantly update our strategies and goals as a complex and dynamic situation changes; “No battle plan survives the first encounter with the enemy.” (Clausewitz, 2004) Additionally, Boyd’s model works well adapted to a more peaceful life and flourishing.

Interestingly, Boyd frequently spoke of an ascending “conceptual spiral” reminiscent of Barbara Fredrickson’s “Broaden and Build” (Fredrickson, 2004). This spiral was an increasingly creative and accurate interaction with reality that lead to greater fulfillment. Boyd described this spiral as continuously improving from education and learning, broadening our ability to adapt and shape our experiences. Most MBAs recognize John Boyd as the creator of his well-respected decision framework, not as a fighter pilot. We will revisit John Boyd and his world again later in this paper.

In the world of aviation the O-O-D-A decision framework was simplified and adapted to become the “3-P model of aeronautical decision making.” The guidance on this system clearly emphasizes fast and frugal decisions. There is a clear caution that we are achieving the best decision given the specific constraints of limited time and information...we are “satisficing” but survival is the ultimate goal in emergencies.

Executive Functions; SHARP and Situational Awareness

The very important source for all our high-stakes time-critical techniques is the development of higher order thinking skills (HOTS) also called executive functioning. Executive functions are a grouping of top-down cognitive tools needed to concentrate, pay attention and stay on task. This is the home of focus, will power, and metacognition. Our human physiology seems hard wired to wander, pay attention to distracting new input or alternatively enter “power saver mode” after a period of time if not stimulated. We are easily distracted by inner and outer interference while already engaged on task. “Executive functions (EFs) make possible mentally playing with ideas; taking the time to think before acting; meeting novel, unanticipated challenges; resisting temptations; and staying focused.” (Diamond, 2012) Two critical component of executive function are focusing for long periods of time, what psychologists call inhibitory control, and also cognitive flexibility, the ability to shift focus or multitask rapidly but effectively. An interesting new government program called SHARP “Strengthening Human Adaptive Reasoning and Problem-Solving” utilizes many of these techniques and others we have discussed here to improve and “advance the science on optimizing human adaptive reasoning and problem-solving in fluid environments” (IARPA, 2014) Though it sounds a bit like the Bourne Supremacy, their techniques are exciting and usable by civilians

Adaptive reasoning and inhibitory control are associated with higher intelligence and superior functioning in high-stakes, time-limited environments.

To maintain mindful “situational awareness” over a period of time it is essential combat the physiological tendency of the mind to shift into the default mode network (I often call this the “power-saver mode” with my flight students) when it lacks new stimulation. To do this and also assure essential data input it is necessary to constantly shift cognitive focus. This is a trick pilots use to maintain the alert monitoring or “situational awareness” (SA). Loss of (SA) can be dangerous in a complex and changing environment due to the loss vital information. In a less stressful situation it would lead to loss of opportunity.

The awareness scan I recommend is called the “micro/macro/meta method” and it involves a conscious, effortful shifting of cognitive focus from the detail level to the larger picture and then to the metacognitive or global view of the thinking process itself. To be successful this has to be continually be cycling in focus to avoid sensory accommodation and the resulting dulling out into brain fade.

If we are involved in detailed work we are optimizing the foveal (center) vision and sacrificing information from the peripheral vision. This is OK for a short time but we are missing critical data and need to continuously shift outward to the macro view to include more opinions, data and perspective. If you are in the macro mode, we must similarly shift into micro mode to examine the detail and validate the bigger picture with a closer examination. Too long on either focus will engender our physiological process of adaptation and diminishing alertness. As every cycle is completed, remember to visit the “meta” or metacognitive view which is larger awareness of how our actual mental

picture is evolving. I call this “angel on your shoulder” for my flight students. This is the global view of an observer watching the agent in action...does this all make sense and pass the intuitive overview?

This most important executive function, metacognition, is defined as “thinking about thinking.” Often characterized by an inner dialogue or reflection on how the larger mental picture is evolving, it is most often accessed in a calm and mindful reflective state. Metacognitively monitoring our tonic state and thinking process is critical in both high-stakes or everyday situations. This maintains our critical situational awareness. It is the perspective that realizes when we are fading and redoubles cognitive scan speed to maintain mental alertness. Our human physiology tends to continually slide into lower state of awareness to preserve energy like the power saver mode on most electronic devices. This is an easy way to get blind sided by a change or miss an opportunity for growth. Csíkszentmihályi’s Flow occurs most typically at levels of optimal challenge and tonicity. The technical term here is syntonic; the optimal balance between stress and hebetude. An overly stressed level of excitement leads to perceptual narrowing from the “fight and flight” reactions and even “mammalian tonic immobility” that precludes any useful activity (“frozen with fear” an adaptive behavior thought to be a result of predation). Interestingly, the military reports that high-performing experts in dangerous, high stress situations actually register a *decrease* in heart rate and blood pressure and increase perceptual ability when the actively engaged in a challenging situation. (Heslegrave & Colvin,1993). More research is needed here but perhaps this is a flow state of expanded consciousness. Another interesting personal report of this phenomenon was a famous Vietnam helicopter pilot, Ron Alexander, who reported that

in combat time slowed down so incredibly that he could see every single bullet fired in his direction. He was the second most highly decorated helicopter pilot in that conflict and never took a single bullet hit to his helicopter despite flying over 125 combat missions and receiving over 40 medals for valor (Alexander & Sasser, 2007). There are many amazing mysteries to still unravel in the human brain!

Resilience

Resilience is the ability to bounce back from adversity or disruption. It requires that we not just prevail and endure but also adapt and grow in response to a disruptive experience. There may be a little truth to my mother's advice "what doesn't kill you makes you stronger." As a person or self-organizing system adapts, this new shield provides another level of defense against future disruptions. There is a penalty with increased resilience however usually represented in greater bulk and inefficiency as a system grows more complex and potentially redundant. Increasingly complex and redundant systems become like a very comprehensive Swiss army knife that can handle any contingency with every available tool but also no longer fits in your pocket. Resilience can be embodied in physical structure. More importantly for our discussion, resilience is also a specific mental posture, predisposition or creative adaptability. The opposite of resilient is brittle. When we fail to bend, adapt, grow the person or system is brought quickly to the breaking point. A telling quote attributed to Darwin was "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change"

On the personal level *The Resilience Factor* by Karen Reivich and Andrew Shatté (2003) is a helpful guide to building resilience. One of their first pillars in the book is to accept that change is possible, embracing what Martin Seligman and later Carol Dweck called a “growth mindset” and engage life with a positive outlook. Next is taking time and accurately assessing and thinking before deciding. They focus extensively on mind traps and the problem of projecting internal conflicts and narrow frames to create a corrupted view of reality (Reivich & Shatte, 2003). This echoes our earlier concern “does my world accurately depict my complex and changing environment?” Do I need to reframe this cognitive map to get beyond my assumptions and beliefs that are coloring this situation? I hope you can see John Boyd’s observe-orient-decide-act behind the curtain here. He provides a very similar format for achieving our synthesis here. Sharing your reality is a quality check recommended by many psychologists. The validating effect of others in a group or team promotes accuracy (or maybe just consensus).

Assembling Our Toolkit for Personal Meaning and Fulfillment

Two authors, both Air Force pilots, sum up what we have revealed in this paper and prescribe a process for adaptive decision making. Using what we have explored, here are the keys to achieving a fulfilling and meaningful life consistent with the tenets of positive psychology. We already discussed John Boyd briefly, the other author is Dr. Tony Kern, a retired instructor at the Air Force Academy. Before we introduce and explore their ideas, let's start with a positive attitude as the essential point of departure and often the most difficult piece of the puzzle for achievement.

An optimistic “growth mindset” is the essential starting point to progress toward meaning and fulfillment in our lives. If we are going to cower and howl like Seligman’s

helpless dogs, nothing is going to move forward. It is essential in life to engage obstacles as “opportunities for growth” and embrace change as a necessary and positive event. Only then can we take the next step and achieve meaningful change. It does take effort and courage to become an assertive empowered decision-maker. As in most challenges the first step can be the hardest. As I mentioned earlier, my recommendation for flight students facing the seemingly overwhelming challenges of endless information and skill acquisition, taking “small smart steps” is a realistic beginning. “Small” is achievable and “smart” is in the right direction, with the likelihood of success given the challenges of the environment. Success and achievement are intrinsically motivational and then hopefully move the project along in a self-perpetuating manner. Once the process is iterated, we are developing good habits and the “good decisions” now become automatic and transparent habits. This is similar to BJ Fogg’s *“Tiny Habits for Behavior Change”* at Stanford (Fogg, 2009). In the case of flight training, I am the coach for achievement and always look for an angle to leverage existing proficiencies into a new domain. I had a young, somewhat timid, home-schooled Christian girl who was unable to take charge. “Meek mouse” is not a good piloting strategy and a long way from “pilot in command authority”. Fortunately I discovered this young lady was also taking karate lessons and had achieved some success here. We were able to leverage this courage and success and apply it to a command attitude in the plane. Hopefully we all have some proficiency we can start from to build a basis for self-efficacy and courage in our lives.

A rich source of research in this area from mainstream psychology is Ryan and Deci’s “Self Determination Theory” (Ryan & Deci, 2000). SDT is a broad theory of

human motivation and optimization, integrating the classical Aristotelian philosophy of eudemonia with mainstream empirical psychology. SDT posits universal human needs of autonomy, competence and relatedness as central to human motivation and flourishing (Ryan, Curren, & Deci, 2013). SDT research focuses specifically on “autonomous motivation,” actions driven from within the self, characterized by authenticity, better psychological and physical adjustment and well-being. With “autonomous motivation” and fully adopted, accurate skills, expert performance efficiently optimizes human happiness and potential. SDT validates the necessity of leveraging our signature strengths and realizing innate potentialities in action. With autonomous motivation, there is no inner turmoil but instead smooth, consistent action in harmony with the perceived inner needs and opportunities of the environment. This is powerful, motivating research for empowered decision making.

John Boyd’s “Observe” step is much more complicated than “look around.” He asserts that clear and objective observation is impossible due to the limitations of our sensory system and the limitations of our processing power. Due to the Heisenberg Uncertainty Principle, human observers are part of the world we are observing and necessarily contaminate the process by our actions...there never can be an “objective observer.” This same enigma is central to Karen Reivich’s *The Resilience Factor* (2002). We always have our “ticker tape” dialogue running that colors our perceptions of the world as we externalize our inner doubts and needs to twist our view of reality. By necessity then our observations of reality are both limited and corrupted. Boyd also cites Gödel’s Incompleteness Theorems which he claims prove any system or model of reality is incomplete and cannot be internally validated (the theorems worked with

mathematics). We need an external source for validation and our paradigm must be continuously refined and adapted in the face of new observations. The “Observe” step is dynamic and continuous and our view of reality is totally hypothetical and humble and must be validated and updated continuously. We are by necessity “satisficing” and to achieve any clarity as an individual (and this applies to institutions perfectly with “group think,” silos and other forms of myopia) we must validate and “orient” through continuous collaboration and consensus. We need to maintain “situational awareness” by cross-checking our “reality” continuously with other people. Our perception of reality is only one small piece of a much larger social fabric. Sandy Pentland’s fascinating *Honest Signals*, provides extensive evidence of our human “hive behavior” (Pentland & Heibeck, 2008) that is apparently part of our evolutionary inheritance. We are always “rubbing antennae” with other humans to effectively “observe and orient.”

Boyd’s view on “Orienting” is covered in his thesis “Creation and Destruction” (Coram, 2002) We are continuously reorienting to maintain pace with our dynamic and changing world. This is totally consistent with Herbert Simon’s theories of “Economic Man” possessing limited in time, information and processing power. Simon posited decisions are intertwined with the environment or “reality” like two blades on a scissors. Checking in with other sources and interacting frequently are essential to a clear, accurate and timely map of reality. How many times have you retrospectively moaned “what was I thinking?” Dan Gilbert’s *Stumbling on Happiness* (2009) is a great resource for humbling the human decision making process.

Growing from the previous two steps, the “Decide” process of taking action is by necessity a hypothesis or “educated guess” in our uncertain environment. Frequently

we use a heuristic or rule of thumb. Knowing our cognitive limitations here is essential for success. If we here channel the wisdom of Daniel Kahneman, we realize we are psychologically predisposed to choose intuitively (and sometimes poorly). As humans we choose what is available: “what you see is all there is.” The skill of metacognition, “thinking about thinking” is essential to determine whether more time and analysis is possible (due to time constraints) or necessary (due to a complex adaptive problem). Even the master of heuristic decision making Gerd Gigerenzer counsels that applying the correct heuristic from the “adaptive toolbox” is critical. (Though it could be argued that a heuristic once analyzed might no longer be “heuristic”) In Gary Klein’s world, if the decision is in our privileged domain of extensive expertise, our “fast and frugal” heuristic decision is likely to be accurate. Otherwise, the unique and new encounter requires more analysis and hence increased cognitive bandwidth.

The “Act” phase of Boyd’s formulation is viewed as an experiment, a test or first hack based on best information and subject to immediate adjustment in the next ensuing O-O-D-A cycle. This decision loop is a learning process, iterative and continuously growing in knowledge and gaining accuracy. We all have a tendency to stay with a decision to amortize the sunk cost and effort. Better by far to test and move on. Guided by heuristic rules of thumb integrated with the metacognitive “does cognitive process make sense” we have an adaptable compass for moving forward. We are the “Administrative Man” with a system of decision tools that are both intuitive and rational in unison guided by metacognition and other executive functions. Dan Gilbert calls our pre-frontal cortex our “experience simulator” one of the new brain functions we evolved in the last two-million years. No need to actually manufacture asparagus ice cream, we

can already intuit the result (Gilbert, 2009) . Additionally, we must let go of perfection as a goal and embrace “the gifts of imperfection” as Brene Brown wonderfully advises in her book. Striving for perfection leads to failure by definition in a constantly changing environment. A reluctance to change and grow makes us brittle and breakable rather than flexible and resilient. Embracing growth and change takes courage and also forgiveness for small failures, compassion and a little humor. Hopefully, “small smart victories” motivate us and move us a step at a time toward a higher standard of excellence, meaning and mastery in our lives.

The one disagreement I have with Boyd’s super fast iterative Observe-Orient-Decide-Act cycle for decisions is his frenetic pace. Between the Observe/Orient phase and the decisive Decide/Act phase, both William Duggan and I would advocate for an essential pause for reflection and breath. This is where wisdom and humanity can flow into our lives. Steven Covey famously observed that all of humanity resides in the essential moment between action and reaction, cause and effect (Covey, 2013). Here also is a home for Barry Schwartz’s *Practical Wisdom* (2010). If we are driven by scripts and rules alone, a heuristically guided missile, we are entirely missing wisdom. Lets take time to please listen to the heart also. As we pause and reflect, we also slow down incessant influx of data and make room for inspiration and illumination in a judgment-free moment. This is where William Duggan’s “strategic intuition” speaks to us. This is where the quiet voices of Barbara Fredrickson’s *Positivity* (2009) can be heard if we are listening. Certainly in high-stakes emergency situations like Gary Klein studies we move directly to action, driven by intuitive heuristics. But in normal life challenges, impulsivity is often the non-adaptive mandate of our biology talking. Wisdom involves examining

our thinking process with our higher order metacognitive abilities and accurately judging the correct decision tool to employ. As William Duggan advised, creating the moment of judgment-free silence is not an easy or even natural habit to develop. It is however so necessary. One major point in this paper is to make sure we get to this point in a conscious, thoughtful manner rather than being blindly driven by external controls. Unfortunately, we are so driven and time starved we really must work hard to pause and reflect. Habit has a place once appropriate decisions consistent with our signature strengths, become natural.

A fascinating recent study by the Imagination Institute at the University of Pennsylvania provides solid neurological support for Duggan's ideas and points the way toward future study in this area. *Default and Executive Network Coupling Supports Creative Idea Production* (Beaty, Benedek, Kauffman, Silva, 2015) supplies neurological evidence that creativity and divergent thinking tasks are indeed found at the intersection of the intuitive and the rational. Using fMRI this research team verified a coupling of the "default network mode" (intuitive internal focus) with executive functioning networks during divergent (creative) thinking tasks. This is very preliminary work but early indications support Duggan's theories nicely and provide a scientific verification of what Duggan has discovered through experience (Beaty, Benedek, Kauffman, Silva, 2015). In Klein's decision model, solutions are retrieved intuitively straight from an archive of rich experience. Duggan provides for the creative solution generation merging intuition and with rational analysis. An amazingly creative solution on January 2009 saved 155 lives when experienced airline pilot like Sullengerger directed his crippled airliner to a landing in a river instead of on a runway. This decision

was not derived from experience (no one had ever even attempted this technique) but occurred at Duggan's intersection of the rational and intuitive/creative working as a team. This is fertile ground for future study.

Our final advisor in this conclusion section is Dr. Tony Kern, another Air Force pilot. He has written extensively on aviation safety and human error; *Redefining Airmanship* (1997) and *Flight Discipline* (1998) but now has leveraged his piloting discipline to create a guide applying these piloting skills to success in daily life. This book, *Blue Threat; How to Wage and Win the Battle Within* (2009), is a guide to "empowered accountability" (Kern, 2009). The term "blue threat" in the military refers to internal, self-induced problems as opposed to external enemy hostilities; "red threat". Though in the psychological realm it is not always entirely clear what is inside and outside, blue or red, Dr. Kern focuses on how we most commonly sabotage our own best efforts for improvement and fulfillment in life. The central focus is to take assertive charge of our lives: "Life is not something that happens to you, you are something that shapes the present and future of your personal and professional life. You intentionally and mindfully create your future by systematically structuring and learning from experience, mindfully living in the present...and seeing and seizing new opportunities in real time." I think this is the essence of living a fully optimized life, the heart of positive psychology, and my best wish for the successful piloting of your life. Go for it; grab it and grow!

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Appendix 1: MAPP Positive Introduction

David St. George, Flight Instructor MAPP10

We often avoid talking about death, or consider it only casually in passing. During the course of our normal, daily existence, the cessation of life from our body is inevitable but consigned to the category of “future and far away.” For people in certain professions, however, like soldiers, law enforcement officers, fire fighters, and even pilots, this cannot be the case if one wants to survive long. A critical element in the preparation for every flight operation is what the Epicureans called “the premeditation of evils” or, colloquially, “how this all could go wrong.” For us, death is a constant companion that keeps us aware and ultimately safe.

When planning a flight, after all the calculations are done, pilots systematically analyze risk factors from an established matrix to ensure we have identified all the risks and potential errors. And again before takeoff, we conduct verbal safety briefings to ensure we are mentally prepared. We are already “code yellow” in our minds. Flying is safe; in fact, it is statistically far safer than driving a car anywhere. But every activity has inherent risks, and a large part of our training as pilots is identifying, managing and mitigating these risks. There is, however, always the stochastic “bolt out of the blue” that we cannot plan for or anticipate.

We could never have foreseen or detected what actually brought us down on this particular night.

My student and I were on a night training flight over the Finger Lakes in a small plane. The weather was clear, and we carefully went through all the required planning. The

aircraft had just completed an FAA-required periodic inspection and had been fully signed off and approved. Everything was normal until about 30 minutes into the flight.

We were at 4500 feet MSL (about 4000 feet above ground) when I thought I heard an irregular pulse in the engine sound—barely detectible, but enough for me to notice. It raised only a slight concern. It was so subtle that I thought, “Am I imagining it or was that an erratic sound?” I glanced at my German student pilot, Ferdinand, to see if he showed awareness of anything unusual. As a flight instructor, one of my major goals is to control and dispel unrealistic fears so students can learn efficiently. Subsequently, we train their attention to what might be actual problems and risks and how to handle these effectively. Ferdinand showed no fear; he had not heard a thing. In the next few minutes, though, the engine problems became readily apparent: the RPM started to oscillate wildly and we began losing power. We were clearly headed down into hostile, dark terrain. During a daytime flight this would have been less alarming, since a safe emergency landing place might have been identifiable. Unfortunately, at night over unidentified terrain, survival was suddenly seriously in question.

Several physical and psychological problems come into play during any emergency situation. It is essential to remain calm and methodically “work the problem” rapidly and correctly, by conducting an initial triage flow and by referencing a code red checklist if time allows. The untrained human response is to relinquish control. In combat, despite their intense training, only 5-10% of soldiers actually fire effectively toward the enemy in actual combat. Most are engaged in some form of cowering, crying or even calling for their mother. To successfully handle this emergency in flight, I needed to stay calm and simultaneously manage my student so he did not panic and create a human interaction

problem in the cockpit. All this is a trained response that must be deeply embedded to be effective.

Though I hadn't worked with Ferdinand for long, I knew that, as a Cornell post-doc, he was both smart and capable. I told him to find the nearest airport and to direct us there while I worked with the engine and attempted to restore normal operation. Once he was involved in a task, Ferdinand became alert and useful identifying a workable divert site. But our engine was still giving up despite all efforts, and now large blue flames were coming out of the exhaust stack as we descended into the night landscape. It was clear that we were not going to have much power to make our destination.

After the reactive adrenaline wears off in your attempt at a best-case triage solution, time slows down, giving you time to work through possible outcomes and develop a plan. But this also leaves the mind prey to panic or resignation. Working from protocol, I had declared an emergency with air traffic control and had Ferdinand direct the plane carefully toward the airport we had chosen. Keeping him actively involved was essential. Conceptually, I needed to use every available resource effectively. But, more importantly, I hoped to keep him involved and functional and prevent him from panicking.

Using the scripted emergency radio call, I told air traffic control, "mayday, mayday," and they replied, "state souls on board and nature of your emergency." This nomenclature made my heart sink as I realized the gravity of our situation. My mind was racing, reviewing past regrets and futures no longer possible. This night, I was thinking of my wife and daughter at home asleep in bed, what I might last have said heading out to fly, as well as what I would never get to say. Controlling the mind is the most essential task in an emergency. In retrospect, I have compared this situation to one of those Upstate winter

nights where you feel the cold relentlessly pushing its way around you. The only recourse is to continually push back and hold the panic at bay.

As the seconds and minutes tick away in an emergency, resignation is another common human response; conversely, visualizing a positive outcome and taking continuous action keeps you engaged on the critical path toward success. I morbidly acknowledge that my relentless optimism has often helped in emergency situations. I always wait for the thought that “we are not dead yet,” and I keep functioning.

Ferdinand and I did make it to the airport this night, but just barely. Every action we performed proved to be essential to our success when we debriefed the flight. At the landing site, a mechanic discovered a serious maintenance error from the inspection that had caused our near-death experience. The inspection we regarded as a sign of health should more accurately have been regarded as exploratory surgery. The inspection and subsequent reassembly rendered the internalized mechanical error undiscoverable.

One almost-funny outcome on the final glide was how easy it was to identify the small airfield with the flashing red lights from our emergency responders. Sleep was a long time coming this night, but never was I so grateful.