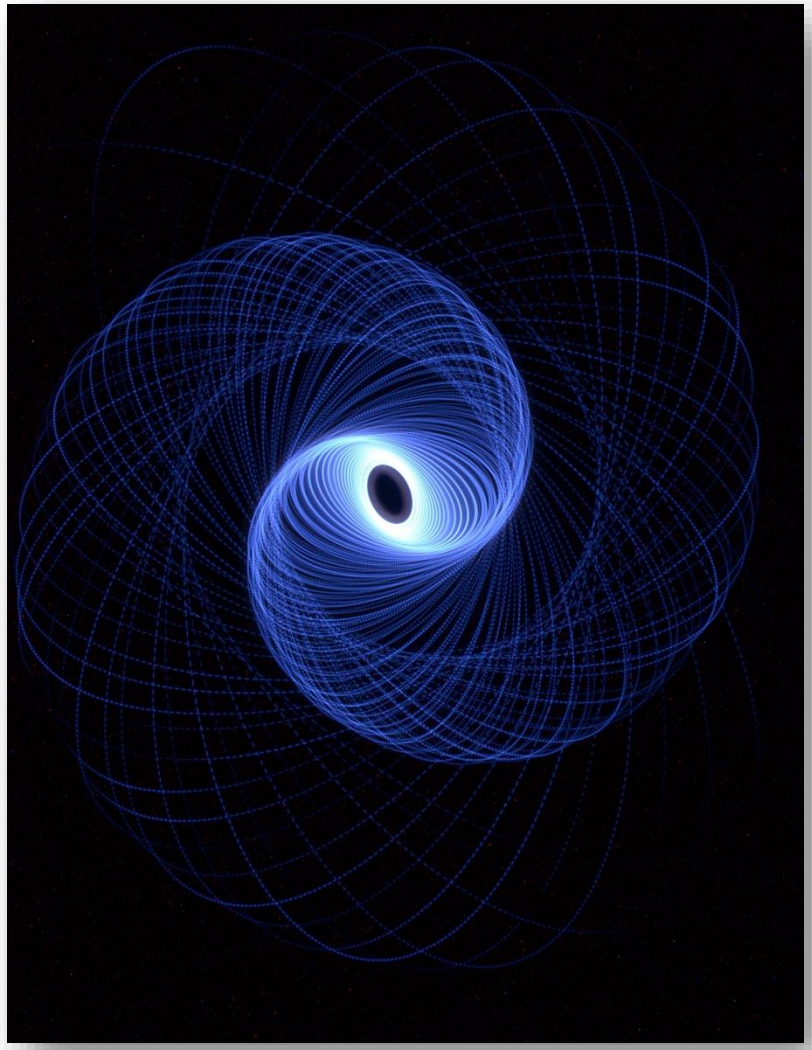
The National FAA Safety Team Presents

Federal Aviation Administration



The Startle Response

Presented to: WAFC and Friends

By: Stephen Bateman, CFI

Date: January 10th, 2022

Produced by AFS-850
The FAA Safety Team (FAASTeam)

Welcome

- **Steve Bateman, CFI, AOPA Director of Flying Clubs**
  - Treasurer, maintenance and safety officer – Westminster Aerobats Flying Club
  - FAASTeam lead representative, Baltimore FSDO
- **Our monthly in-and-out safety meeting using the FAASTeam Topic of the Month**
- **Sponsor Acknowledgment – WAFC, AOPA, FAASTeam, Baltimore FSDO**
- **WINGS Credit: Yes…but give me a day or two…**
- **Probably no time for questions, but send email: steve.bateman@aopa.org**

Check NOTAMS!

VIP TFR OVER WILIMINGTON, DE BEGINNING
TODAY SATURDAY, MARCH 6, 2021

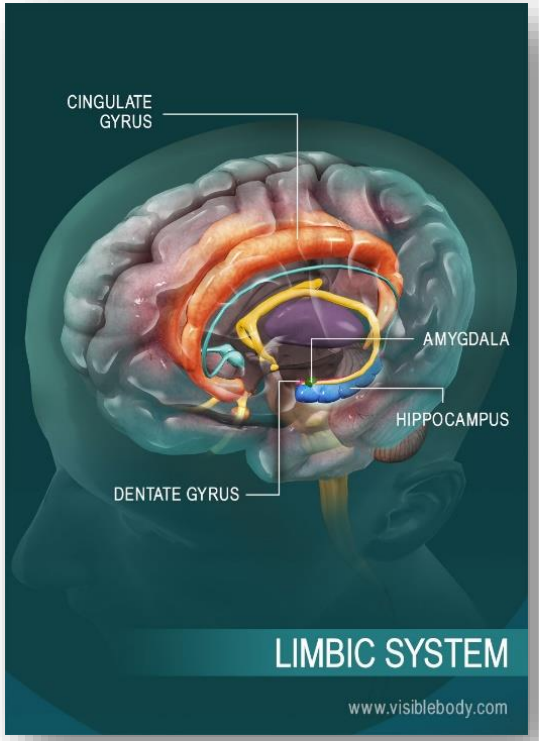
VIP TFR OVER HAGERSTOWN/THURMONT, MD
BEGINNING FRIDAY, APRIL 2, 2021
(((CHANGE IN DEPARTURE TIME)))

Overview

- Why are we talking about this?
- Possible situations
- Startle response – what is it?
- Why does it happen?
- Human response to stimuli
- Examples
- Hazards to general aviation flight operations
- What we must do about it

Why we are talking about this…

- **Fatal LOC GA accidents may result from inappropriate responses to unexpected events:**
  - Frozen into inaction (Limbic highjack)
  - The limbic system is **the part of the brain involved in our behavioral and emotional responses**, especially when it comes to behaviors we need for… survival…& fight or flight responses
  - Improper response due to:
    - Incorrect initial reaction
    - Delay in reasoning
    - Don’t know what to do
      - Never knew
      - Forgot
      - Don’t practice

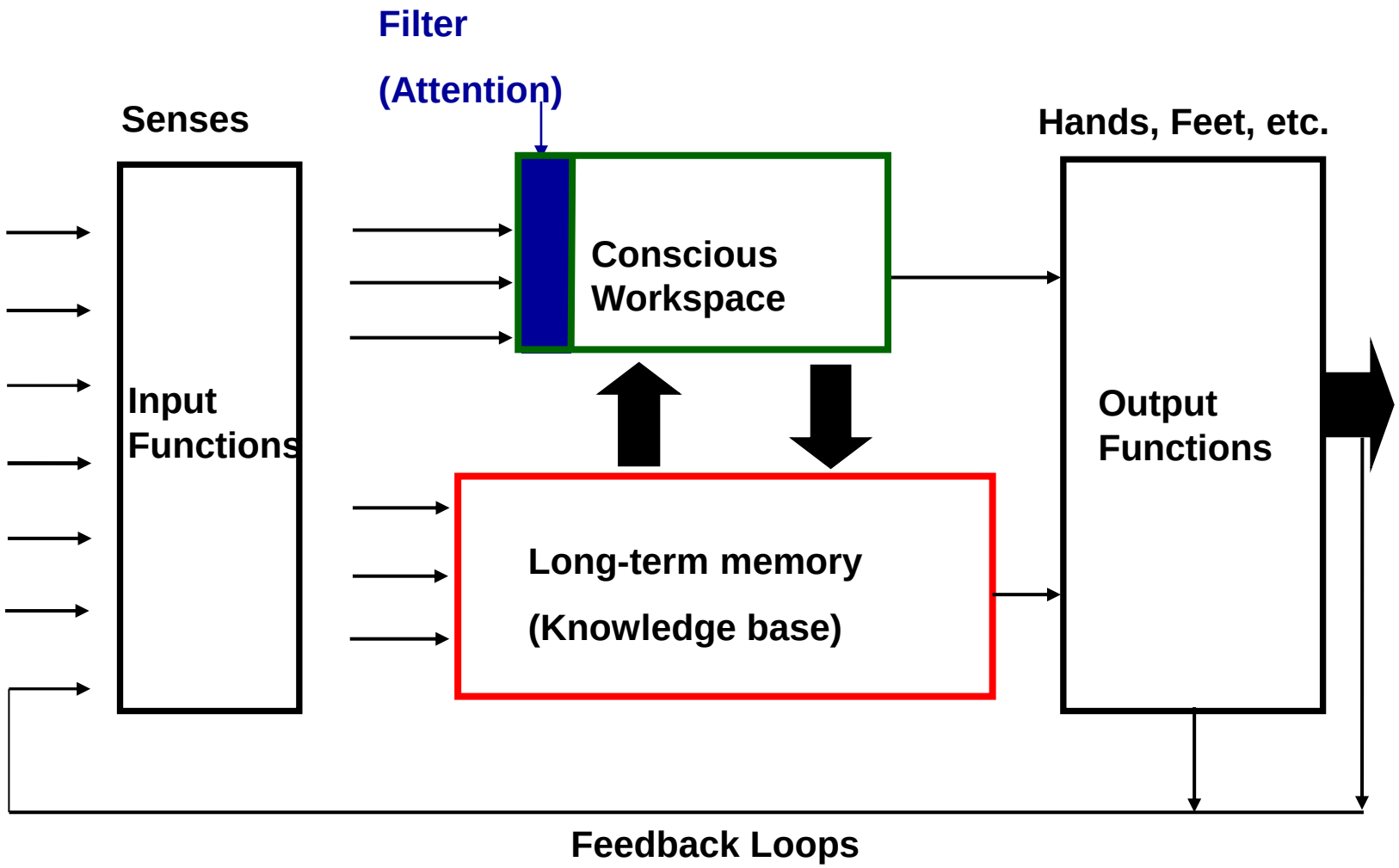


Possible situations

- Engine failure on take-off (and go-around)
- Landing gear extension/retraction problem
- Landing gear warning horn
- Bird strike
- Cabin door opening
- Seat belt trapped outside and banging
- Control issue/failure
- Alarms (e.g., Altitude alert set too low)
- Flashing warning lights

'#$@! we're going to crash! This can't be true! But what's happening?'…were the last words from pilot David Robert on board Air France flight 447 as it crashed into the Atlantic ocean, in June 2009 killing all 228 on board.

Flight Safety Australia:
https://www.flightsafetyaustralia.com/2015/08/without-warning-the-startle-factor/



A Simplified "Blueprint" of Mental Functioning

•James Reason & Alan Hobbs (2003)

Conscious Workspace

- Sequential processing
- General problem solving
- Limited capacity
- Slow and laborious
- Essential for new tasks

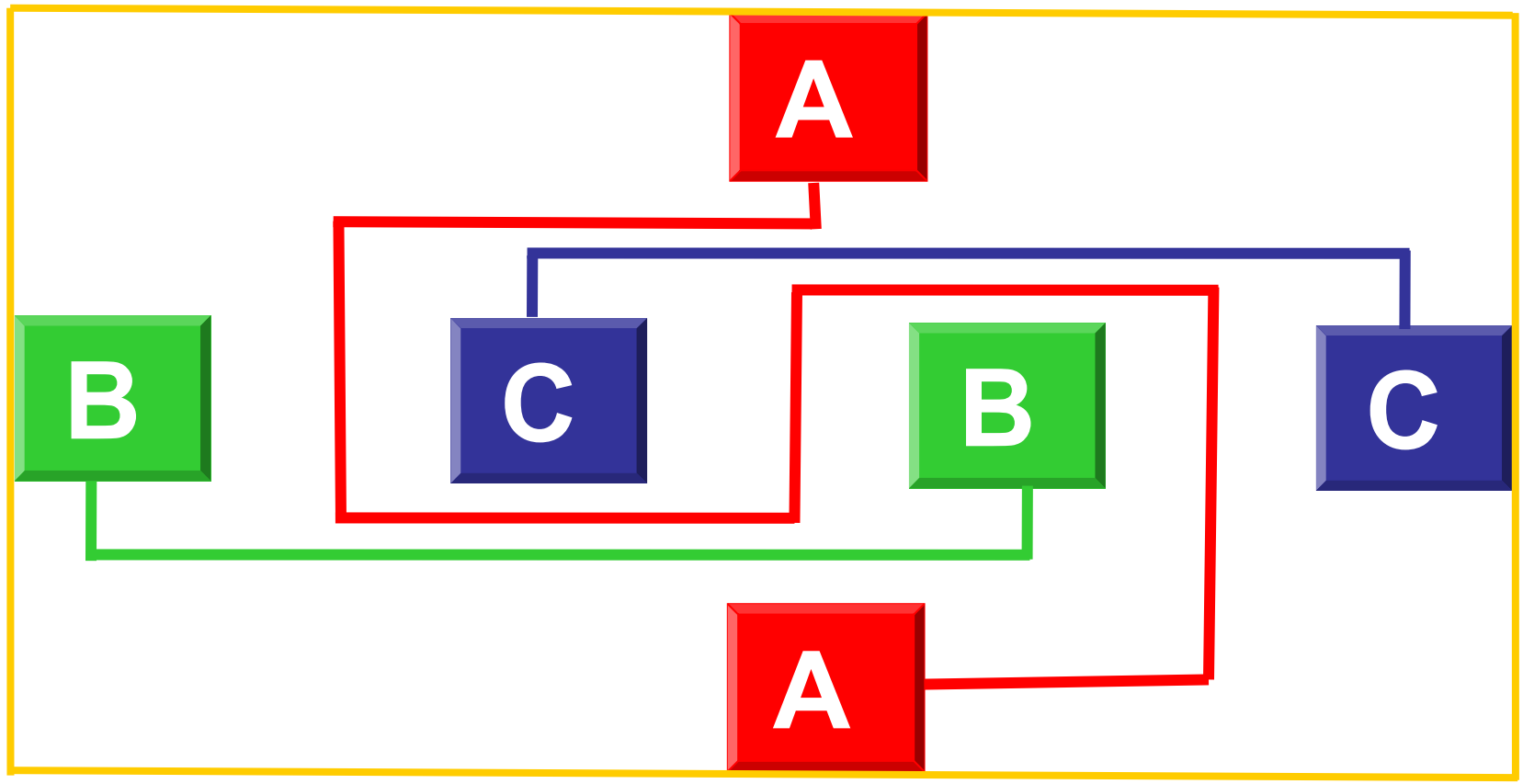
Long-term Memory

- Parallel processing
- Vast collection of knowledge
- No limits to size or duration
- Unconscious
- Rapid and effortless
- Handle familiar routines and habits

Trial and Error

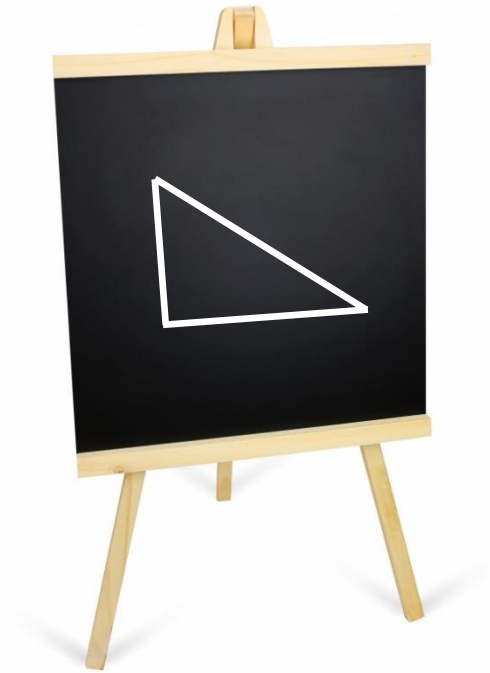
Programming

Conscious Workspace



Long Term Memory

- Mary had a ……..
- 2 x 2 = …….
- The square of the hypotenuse of a right-angle triangle is equal to ……



Wee r creatuers if hbaet

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Pliots are paticrculry aedpt ta ptatren rcoegiontin und ulusaly taht wokrs wlel for tehm but oaccsillony taht hmaun tenendcy cuseas prelombs.

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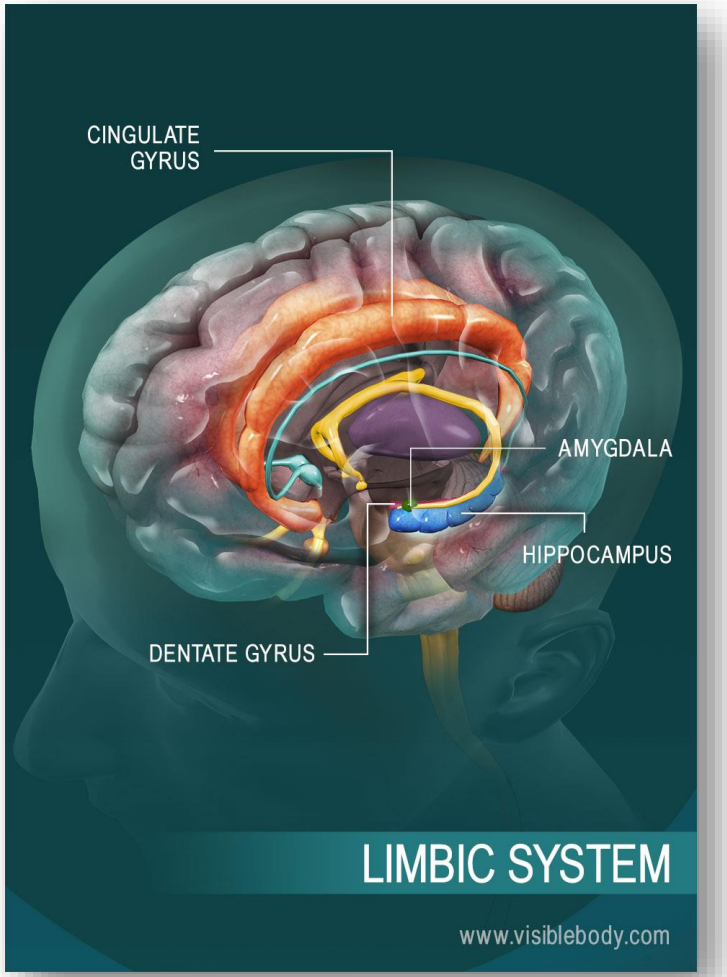
Surprise and Startle

- **Surprise**
- The psychology of surprise is about how people respond to unexpected events (Wickens, 2001). Surprise results from a disparity between a person's expectations and what is actually perceived (Horstmann, 2006).
- **Startle**
- The startle response/reflex is the first response to a sudden, intense stimulus. It triggers an involuntary physiological reflex, such as blinking of the eyes, an increased heart rate and increased tensioning of the muscles—necessary to prepare the body for the fight-flight response (Koch, 1999).

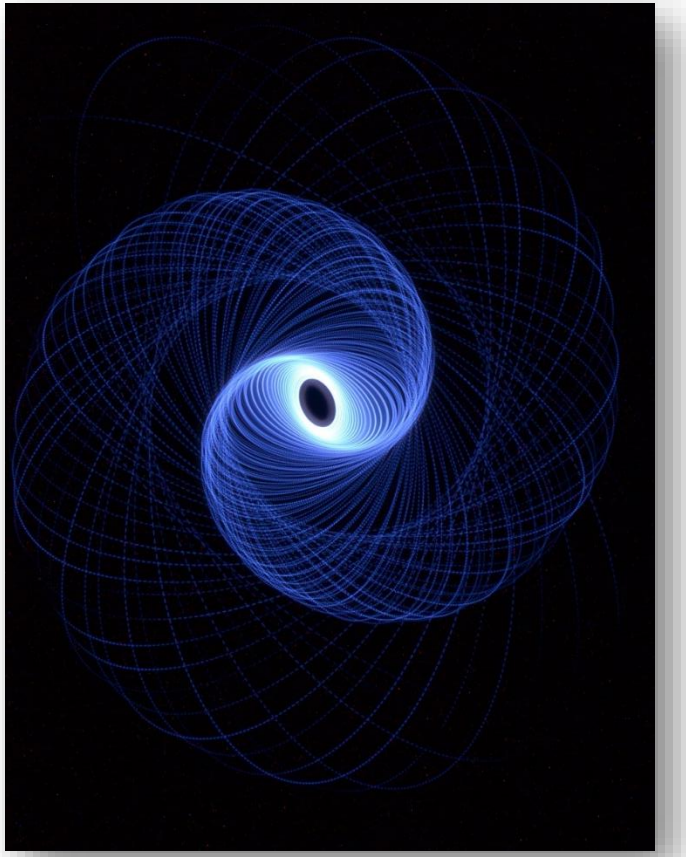
The human startle response

- **Nearly immediate access to memory and action**
- **Deep seated, reflexive reaction**
  - Fight or Flight
  - May save you on the ground
  - May kill you in the air



The human startle response

- **Nearly immediate access to memory and action**
- **Limbic highjack**
- **Deep, reflexive reaction to a perceived harmful event:**
  - Fight or Flight
  - Can be great on the ground
  - May kill you in the air
- **Worst case**
  - Vortex of sensation



The “Startle Response” in Aviation…

An automatic reflex that is elicited by exposure to a sudden, intense event that disrupts a pilot’s expectations.

Oh…nothing can go wrong, then…

What does it do in humans?

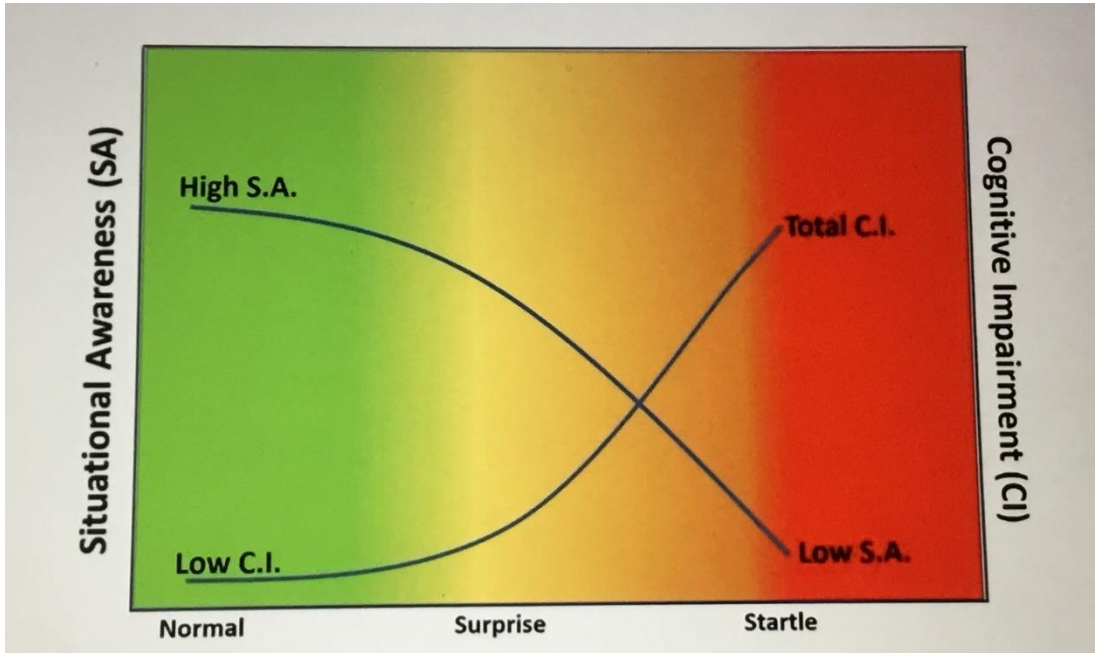
- **Brain activity changes:**
  - Think less and react more
  - Heart beats quicker
  - Blood pressure rises
  - Breathing rate increase
  - Liver release more sugar…for energy
  - Muscles tense for action
  - Adrenal gland release adrenalin to heighten response

What does it do?

- **The fight or flight response enables us to react with appropriate action:**
  - Running away
  - Fighting an attacker
  - Become frozen, allowing ourselves to become a less visible target
- **Unfortunately, fight or flight can also lead to inappropriate actions**

What does it do?

- **Actually, two parts to it…**
  - Reflexive fast system acts within 1/12th of a second (~80ms)…just happens, no real thought involved
  - Slower system sends information for evaluation…think about it
- **Initial startle can last up to 30-seconds…**
- **Instantly erodes (destroys) situational awareness**
- **Once headed down a response path, it is *very* difficult to stop, regroup and reevaluate**



Interesting…

- **Different people startle differently**
  - Calm types vs. nervous types…?
  - Low reactors—ideally all pilots…
  - Super startlers—prone to adverse reactions and poor performance to startle events
- **Same person may react differently on different days…**
  - Make your “level of hyperness” part of IMSAFE
    - Emotional state, stress levels and attentiveness

Example

- At a traffic signal, two large trucks either side
- One truck slowly edges forward
- Startle!! Vertigo!!
- Reaction…jam on your brakes as you are convinced that you are moving backwards
- Takes several seconds for the reaction to be replaced with reasoning…

Is today's pilot more susceptible to startle?

- **Back in the day…failures were more prevalent, so pilots were spring-loaded for an event**
- **Training was different back then. Full stalls, actual spin recovery**
- **Due to orders of magnitude increase in reliably, we have an expectation of normalcy, and we don't really believe that we'll have a failure, so any event is *even more* startling**
- **NASA LOC study: "…deterioration of manual flying skills due to increased reliance upon automation is a strong contributor…This deterioration in skill provides further encouragement to place even more emphasis on automation and less on manual flying"**
- **Perhaps today we are not trained to be so spring-loaded…and when it happens, we take no action (shock), wrong action (waste time), or inappropriate action (that gets us in deeper)**

What must we do about it?

- **We can—and should—do something about this!**
- **The ACS is for check ride standards, not for survival…**
  - Check rides rarely include startle-type events!
- **Brief and verbalize to get potential events in your head…**
- **Always:**
  - Brief and verbalize the take-off including actions on power failure
    - Runway, abort point and procedure, no turn until…
  - Brief and verbalize the approach, go-around and landing
    - Runway, planned exit taxiway, flap settings, things to watch for (that a/c at the hold line…)
    - Go-around procedure
- **Constantly strive for situational awareness**
  - More than monitoring…cross-check status of automation, systems, navigation, environment…

What must we do about it?

- **We must train further…**
- **We must increase our knowledge and experience base**
  - We can only correctly respond if we have some idea what to do!
  - We must train to recognize “more” then that which is perceived to be normal
    - First flight with an autopilot that blares at 1,000’ vs. second flight when you know what it is
  - Train to “feel” what is happening, rather than solely rely on automation
    - Yes, yes…trust you instruments, but cross-check with experience
  - Train for a “push” reaction, not “pull”
- **Simulator exercises—practice the unpracticable**
  - All systems—engine, fuel, gear, hydraulics, avionics,
  - Even desktop simulations have “random failure” modes
  - Gives us more—and sharper— tools in our experience toolbox
- **Armchair exercises…what would I do if…?**
- **Expanded envelope exercises**
  - Accidents can happen when pilots are outside of comfort zones…so expand them
- **Upset recovery training**

What must we do about it?

- **This is what we MUST be doing on flight reviews, not just reevaluating to the ACS!**
  - Take control of your flight review!

- ***WINGS* flight activities gives an opportunity—fly three time with a CFI…do something different!!!**

So how do we prepare for the unexpected?

- **Consider the hazards associated with each phase of flight**
  - Assess what could go wrong
- **Plan for how you would deal with the problem**
  - What would I do if…?
- **Train**
  - Practice—preferably with a CFI
  - In a simulator—practice the unpracticable
  - E3—Expanded Envelope Exercises
    - Enlarge your comfort zone

Scenario-based flight instruction

- **Replicate typical mission parameters**
  - Address identified risk areas within mission context
  - Operations near max gross weight
- **Brief for each flight phase**
  - Takeoff, climb, cruise, descent, approach, landing
- **Unannounced emergency simulations**
  - Use extreme caution when close to the ground
  - If safe – continue power loss scenarios to landings

Then fly the way you train

- **Practice Safety Risk Management**
  - Identify hazards and risks associated with your missions
  - Use a Flight Risk Assessment Tool (FRAT)*
- **Brief before you fly**
  - Even if you're the only pilot in the airplane
    - What you expect will happen
    - What you'll do if …..
- **Train to Proficiency**
  - Consider ***WINGS*** Pilot Proficiency Training

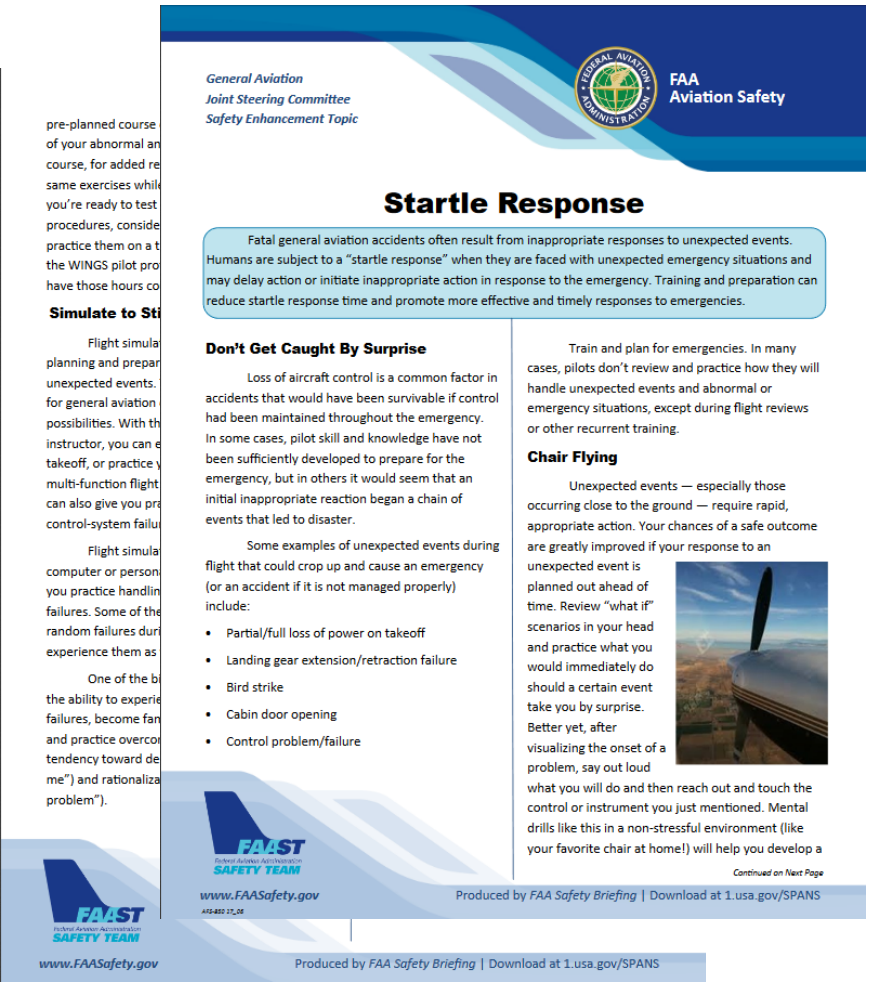
*https://faasafety.gov/gslac/ALC/lib_categoryview.aspx?categoryId=31

Learn from past startle induced confusion accidents:

- **Turkish Airlines Flight 1951, 2009**
  - Fault with LH seat radio altimeter – indicated -8 feet
  - Systems enter “retard flare” thrust condition
  - Speed decays, stick shaker
  - First Officer applies partial thrust, but auto throttles reduce thrust to zero
  - Captain takes over – thrust stays at zero for nine more seconds
  - Unable to recover from stall at ~450’ AGL
- **Colgan Air Flight 3407, 2009**
  - Commencing approach from 2,300’
  - Flaps and gear down
  - Power left at idle
  - Stall waning and stick shaker…
  - Startle! Reaction was to pull.
  - Deeper stall, FO retracts flaps…
- **Air France Flight 447, 2010**
  - Atlantic Ocean
  - Pitot becomes blocked by ice
  - Autopilots disconnects
  - Stick shaker and stall warning
  - First Officer pulls up at 2,000’
  - Fully developed stall – pulls full up

We must train for the initial reaction to PUSH, not pull.

More Information?



General Aviation
Joint Steering Committee
Safety Enhancement Topic

FAA
Aviation Safety

Startle Response

Fatal general aviation accidents often result from inappropriate responses to unexpected events. Humans are subject to a "startle response" when they are faced with unexpected emergency situations and may delay action or initiate inappropriate action in response to the emergency. Training and preparation can reduce startle response time and promote more effective and timely responses to emergencies.

Don't Get Caught By Surprise

Loss of aircraft control is a common factor in accidents that would have been survivable if control had been maintained throughout the emergency. In some cases, pilot skill and knowledge have not been sufficiently developed to prepare for the emergency, but in others it would seem that an initial inappropriate reaction began a chain of events that led to disaster.

Some examples of unexpected events during flight that could crop up and cause an emergency (or an accident if it is not managed properly) include:

- Partial/full loss of power on takeoff
- Landing gear extension/retraction failure
- Bird strike
- Cabin door opening
- Control problem/failure

Train and plan for emergencies. In many cases, pilots don't review and practice how they will handle unexpected events and abnormal or emergency situations, except during flight reviews or other recurrent training.

Chair Flying

Unexpected events — especially those occurring close to the ground — require rapid, appropriate action. Your chances of a safe outcome are greatly improved if your response to an unexpected event is planned out ahead of time. Review "what if" scenarios in your head and practice what you would immediately do should a certain event take you by surprise. Better yet, after visualizing the onset of a problem, say out loud what you will do and then reach out and touch the control or instrument you just mentioned. Mental drills like this in a non-stressful environment (like your favorite chair at home!) will help you develop a

Continued on Next Page

FAAST Federal Aviation Administration SAFETY TEAM

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Produced by *FAA Safety Briefing* | Download at 1.usa.gov/SPANS

- FAA Safety Briefing, "When the Best Made Plans Go Awry" Nov/ Dec 2010 http://1.usa.gov/2p2W20
- FAA Safety Briefing, "Between a Rock and Hard Spot- Handling a Partial- Power Takeoff", Nov/ Dec 2010 http://1,usa.gov/292UIYY
- Risk Management Handbook, Chapter 5: ADM; and Chapter 6: Single Pilot Resource Management http://go.usa.gov/x9gnj

Have you earnt your *WINGS*?

- **Proficient Pilots are:**
  - Confident
  - Capable
  - Safe
- ***WINGS*** will keep you on top of your game

Proficiency and Peace of Mind

- **Practice makes you better and might save your life!**
- **Fly often with a CFI**
- **Training is credited**
- **WINGS participation can save you money**
  - Insurance discounts
  - Less bent metal!

Thank you for attending!

You are vital members of our GA safety community!

Next Month's ToM:

The National FAA Safety Team Presents

Topic of the Month - February

Expanding Your Horizons
Stall, Spin and Aircraft Upset Training

Presented to: WAFC and Friends

By: Stephen Bateman, CFI

Date: February 14th, 2022

Produced by AFS-850
The National FAA Safety Team (FAASTeam)