Examining the startle reflex, and impacts for radar-based Air Traffic Controllers

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Fun Fact

Ciseau is French for “Scissor”

Background – About me

- Air Traffic Controller with Airservices Australia since 2009

- Based in Brisbane Centre 2010-2017 in radar arrivals/departures north/east of Sydney

- Now based in Initial Training in Melbourne as an ATC Instructor

- Completed a Masters in Science and Technology (Aviation) in 2016

- Research topic on the startle reflex and its effect on radar-based air traffic controllers

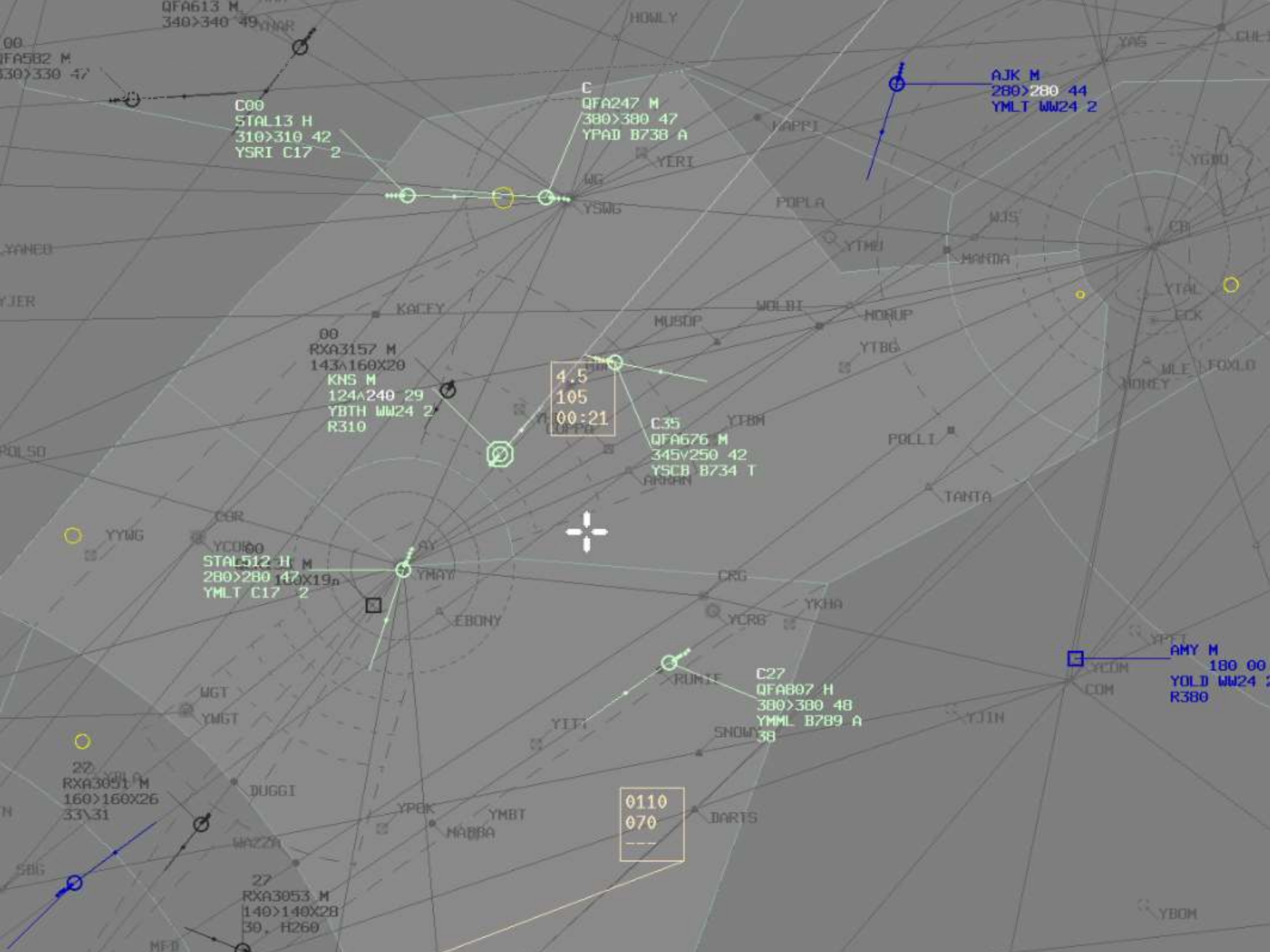
A bit about radar air traffic control

- En-route radar environment – traffic is visible and in direct radio communication continually

- Objective, separate the aircraft. For en-route radar controllers, this means 5 nautical miles or 1000 feet apart at all times.

- Therefore, avoid a “Loss of Separation Assurance” (LOSA) or a “Loss of Separation” (LOS) incident.

- Should a LOSA or LOS occur, controllers are expected to solve the confliction using special phraseology e.g. “*Alpha-Bravo-Charlie AVOIDING ACTION/SAFETY ALERT, TURN LEFT IMMEDIATLEY Heading 270*”.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What is the startle reflex?

- “An autonomic/involuntary reaction to a stimulus, which has the potential to elicit surprise and fear within an individual.”

- Occurs when exposed to surprising stimuli, comprised of auditory and/or visual inputs. For ATC, this can mean alerts or alarms

- Has the potential to deteriorate into behaviours such as freezing, denial or refusal to believe certain events are occurring.

- The amygdalae form part of the limbic system within the brain, and is connected widely to other areas of the brain.

- Has a large role in processing fearful and emotive memories, making rapid assessment of threats, prior to full cognitive processing.

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Why look into the startle reflex?

- “Crash comics” or incident reviews; “How can controllers be so silly?”

- How can highly trained, intelligent, experienced controllers end up in situations whereby aircraft under their control end up in a “Loss of Separation Assurance (LOSA) or a Loss of Separation (LOS)?

- How can these controllers ignore auditory/visual cues such as collision alerts and other controllers pointing conflictions out?

- Anecdotally, there seems to be no age, experience, environmental patterns that can be isolated as to why, and who this is occurring to.

- The training/documentation that follows may be aimed at the symptom and, not the cause of the issue.

Examples of the startle reflex

- The controller likely has an incorrect mental model of the situation
- Time 0800:26 the Short term conflict alert (STCA) activates
- At 0800:32 an adjacent controller uses the intercom system to alert the controller to the closing speed between the two aircraft
- At 0800:41 the required separation between the aircraft is lost
- At 0800:45 the controller conducts co-ordination regarding another aircraft to a different controller
- At 0800:54 the controller replied to QLK117D regarding the extent of delays into Sydney
- At 0801:08 the controller asked QLK117D to turn, but did not include any actual instructions to the aircraft
- At 0801:29 the controller turned another aircraft not involved in the conflict
- At 0801:50 the controller again asked QLK117D to turn, but did not include any actual instructions to the aircraft
- During the incident the other aircraft RXA333 was assigned descent back through the level of QLK117D. Not further control instructions were issued.

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Examples of the startle reflex

Sinking of the ferry *MV Estonia*

Sinking of the *MV Estonia*

- A series of loud bangs were heard, as the bow visor/cargo door separated from the ship.

- Resulted in a very quick loss of engine power and electricity, and the ship rolling 30-40 degrees very quickly.

- Rescue and survivor report passengers still in their cabins, sitting in corridors, standing frozen in staircases and unresponsive to offers of help from crew and fellow passengers.

- Reactions show the overwhelming potential of the startle reflex, and its ability to further degrade into freezing and denial of threats. Interestingly, research suggests 10-15% of people will maintain clear, concise thinking, and able to display leadership and problem solving.

What is actually going on?

- Startle. Some FAA definitions from relevant training circulars;

“An uncontrollable, automatic muscle reflex, raised heart rate, blood pressure, etc., elicited by exposure to a sudden, intense event that violates a pilot’s expectations.”

- Surprise

“An unexpected event that violates a pilot’s expectations and can affect the mental processes used to respond to the event.”

What is actually going on?

- Freezing

A term used to describe behaviour where an individual appears to have "frozen" or being inactive where normal training or experience would dictate a required response.

- Denial

Likely a psychological defence or coping mechanism. The mind allows only limited negative or threatening information through to reduce stress and anxiety.

Research into startle in aviation

- Wayne Martin conducted a PhD on the effects of startle, freeze and denial for pilots.

- 24 pilots flew simulated scenarios where they were exposed to a startling stimulus during a critical phase of flight

- 1/3 performed normally, 1/3 slightly delayed, 1/3 showed “interesting performance and behaviours” likely due to startle

- No correlation between reaction times and flying hours, rank, but a small correlation between larger reaction times and those aged 45+

Research into startle in aviation

- NASA conducted a study in 2015 testing 747 captains for reactions to stall and stall warnings.

- Stalls during expected phases of flight were all handled correctly

- Stalls at unexpected phases of flight were “frequently handled differently” despite the same control inputs and response being required.

- What does this tell us about the mental models of pilots and ability to respond to unexpected scenarios?

The startle reflex and training

"We do not rise to the level of our expectations. **We fall to the level of our training**." -- *Archilochus, Greek Soldier, 650 BC*

Changing the focus of training

- The aviation industry is changing the focus of training after many high profile accidents involving human factors, most famously Air France 447

- The FAA introduced two advisory circulars, *'Upset prevention and recovery training'* and '*Stall prevention and recovery training'*

- These shift towards evidence based training as opposed to recurrent training programs, allowing operators the flexibility to target training to areas other than those prescribed in regulation

Can we train against startle?

- Studies suggest we ***may*** be able to help train against startle and build resilience

- Evidence that neural pathways can be altered by a process call “Long-term potentiation”, where neural synapses are strengthened based on recent patterns of activity.

- “Stress Inoculation Training” or SIT, is also used in military, police and first responder training overseas. This method deliberately subjects individuals to stressors, in order to build resilience.

The startle reflex and training

The startle reflex and training

Some of the simulator capabilities;

- Add conflicting aircraft, VFR airspace infringements etc.

- Change rate of climb/descent to create conflicts

- Turn aircraft unexpectedly / vector aircraft

- Turn off/on transponders for aircraft

- Instantly change the current altitude of aircraft

The startle reflex and training

Possible startle inducing scenarios may include;

- Artificially placing two aircraft in close proximity, so they short term collisions alert (STCA) activates with a visual and aural alarm.

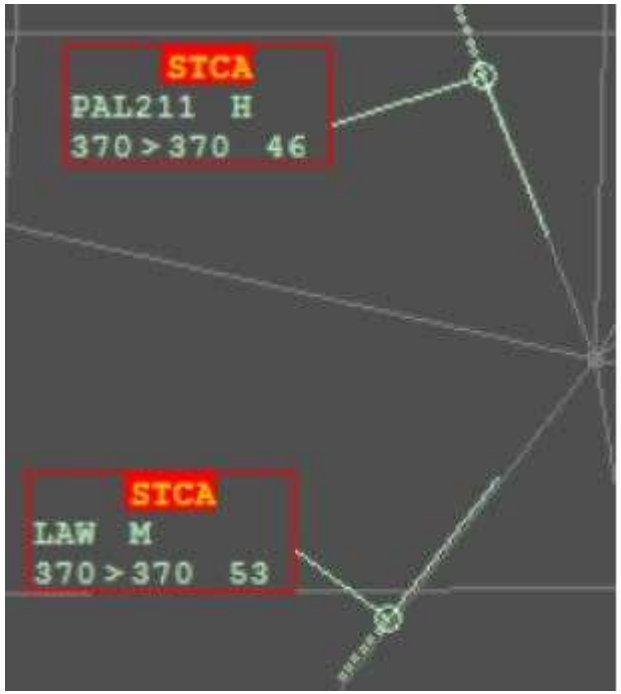
- Aircraft conducting emergency descent

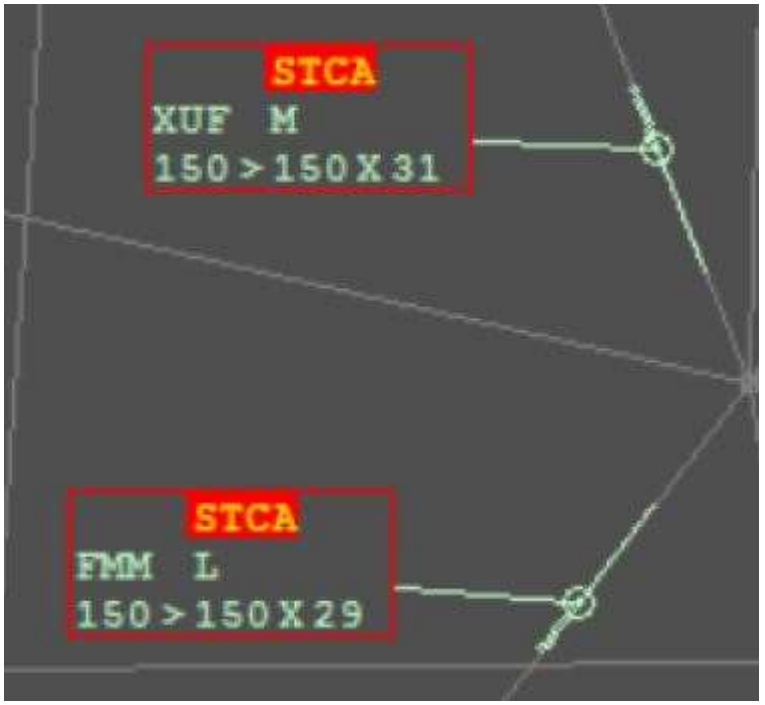
- Total radar failure, resulting in no aircraft being visible to the controller

- Unexpected activation of the Danger Area Infringement Warning (DAIW) and Minimum Safe Altitude Warning (MSAW)

The startle reflex and training

Visual vectoring tool





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Time to experiment…

The startle reflex and training

- Trainees grouped into courses, usually between numbering 6-8

- Potential for control groups, and one or two variables for others

- Fixed curriculum, bound by RTO regulations and principles

- Exercise manipulations or additions designed to activate STCA, and test the controllers abilities to deliver control actions that resolve confliction, using the correct phraseology

- Testing the ability to overcome incorrect/outdated mental models, and maintain composure to resolve safety critical situations.

- Ability to record, measure and rank response times, distances etc.

What could we hope to find?

- There may be value in training for resilience to allow controllers to manage unexpected events with their full cognitive capability

- Reduced focus on training for outcomes versus building controller capability, much like pilot training

- Spill-over into operational ongoing training, are there potential benefits for our current rated controllers?

- What frequency of training best enables controller resilience to startle and surprise to be achieved?

Review

- The startle reflex is real, has the ability to effect everyone and a real threat of degraded performance exists

- Aviation industry training recognises that additional evidence based training is required to ensure competency in this area

- The simulator provides us with a safe environment to challenge controllers reactions to scenarios where mental models are incorrect

- Hoping to build resilience in controllers through targeted training.

Thanks for your attention!