

# UPRT in the Simulator

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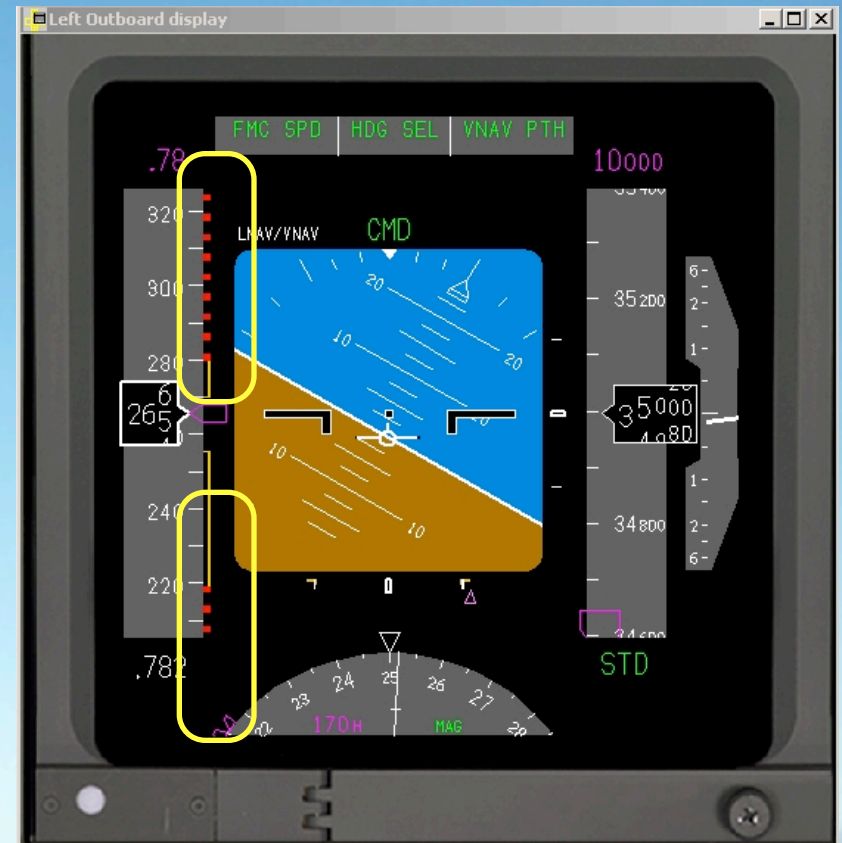
# Simulator Training

- Simulator Capabilities
  - Controlled environment for UPRT “to proficiency” and generic skills development
  - Ability to create realistic type-specific scenarios
- Simulator Limitations
  - Validated Flight Envelope
  - Limited g-cues
  - Instructor ability to monitor control inputs



# Accelerated Stall Demonstration

- Aerodynamics and handling at FL150 and FL350





# Sim Fidelity Enhancements

- **Better** use of today's devices
- **Enhanced** feedback in today's sim's
- **Improved** simulation fidelity in extended envelope
  - aero model
  - pilot cueing (buffet, motion)



# Sim Instructor Feedback Requirements

- Did you stay reasonably within the validated flight envelope?
- Did you overstress the airframe?
- Did you apply incorrect/inappropriate control inputs?
- Did you recover correctly?

# UPRT IOS Tool







The tablet interface shows a flight simulator with the following elements:

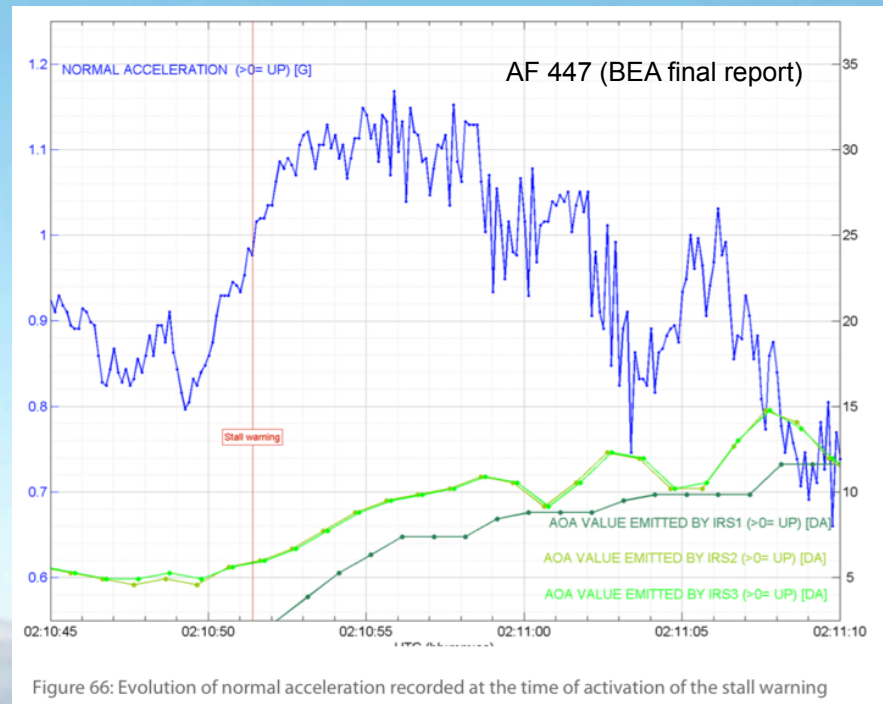
- Top Left:** A/P and A/THR status (OFF). A circular plot showing altitude (200-280) and airspeed (20-40) with a green dot at 238 and 39.
- Top Right:** A graph of Normalized Vertical Speed (Nz) vs. Vertical Speed (Vias). It shows a yellow curve and a red loop. Text:  $V_{sw} = 229 \text{ kts}$ ,  $1.1g$ .
- Bottom Left:** A grid plot with axes DN, LT, RT, and UP. A red diamond and a green dot are visible. Below it is a "rudder pedal position" slider.
- Bottom Center:** Aircraft settings: GW: 288 T, CG: 19.5%, Stab: 4.9. Includes gear and flap controls.
- Bottom Right:** A graph of Roll Rate (ROR) vs. beta. A red dot is at approximately (5, 0).
- Right Panel:** A vertical menu with buttons: Clear All Data, Clear Vn and Alpha/Beta, Expand Vn, Insert Time Marker, Show Time Plots, Select New User, Audio Enabled, Show Debug Page, and Quit.
- Bottom Bar:** 0.00 User: Advani Case # 15.03.01 21.15.17 Select Replay **PLAY** Time: 16.7 End Playback Replay Last 82.1

- Control Inputs
- Aircraft settings
- Flight Modes
- PFD
- V-n
- Alpha-Beta
- Replay function with audio



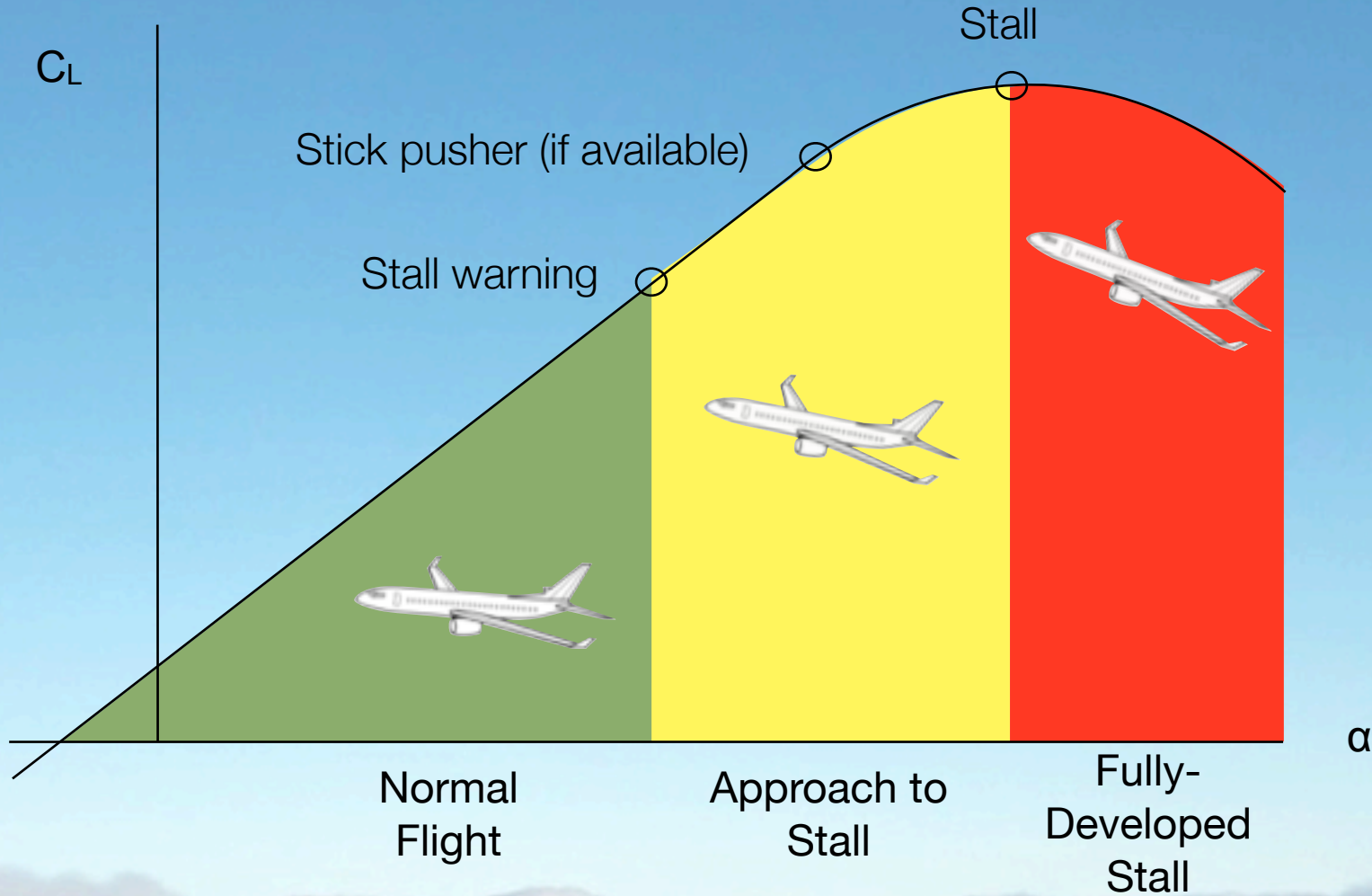
# Buffet

- Critical for crews to understand buffet (causes, effects):
  - high-speed VMO/MMO buffet
  - stall onset/deterrent buffet
- Appreciate that buffet may not always be consistent
- Buffet  $\leftrightarrow$  warnings
- Sim buffet tolerances





# Stall Training







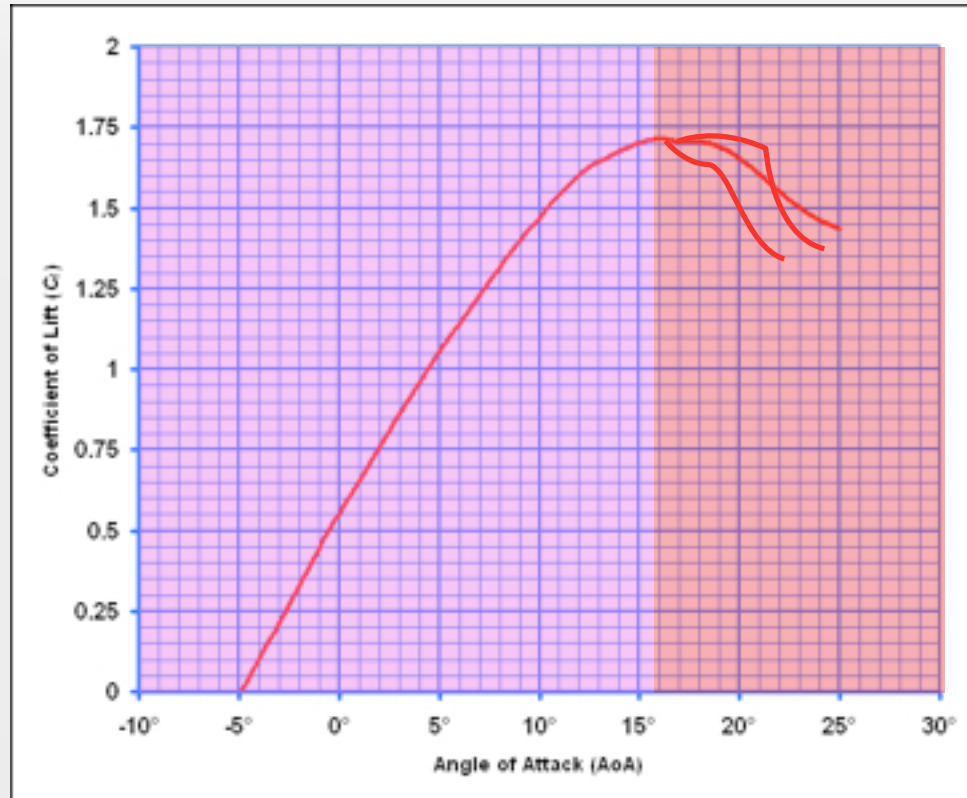
# Model Enhancements

- A/C can have major non-linearities near and beyond stall break
- These can create distractions to the crew, as in real life
  - reduced stability
  - reduced control effectiveness
  - buffet
  - un-commanded roll-off
  - randomness
- US Law requires training to full stall

# Non-linearities in Stall Region

Approach-to-Stall

Stall






# Is there value to stall training in FSTD's?

- Arguments against
  - prevention alone is enough
  - no two stalls are the same
  - danger of negative training
  - cannot create surprise in simulators
- Arguments in favour
  - goal: show potential changes in a/c behaviour near stall
  - history: pilots continue to pull near the stall
  - an instructor-led exercise can teach the single important element: **PUSH**
  - one CAN create surprise in simulators
  - objective is to manage unexpected events

A photograph of a pilot's arm and hand on the controls of an aircraft cockpit. The pilot is wearing a light blue shirt and a black watch. The cockpit is filled with various instruments, dials, and control panels. The background shows the sky through the cockpit windows.

Upset Prevention & Recovery Training  
**Prepare to be Surprised**

# Recent FAA Experiment

- Conducted on 737NG FFS at FAA Oklahoma City
  - Evaluate training benefits of three stall model types:
    - current model (matching flight test data to within a tolerance)
    - representative
    - flight-test validated
-  *“No two stalls are the same”*
- Models assessed in low, medium and high-altitude conditions
  - Crews briefed on the sim, asked to apply OEM stall recovery template (see next slide)



# FAA Boeing 737 Simulator



# Abbreviated Stall Recovery Template

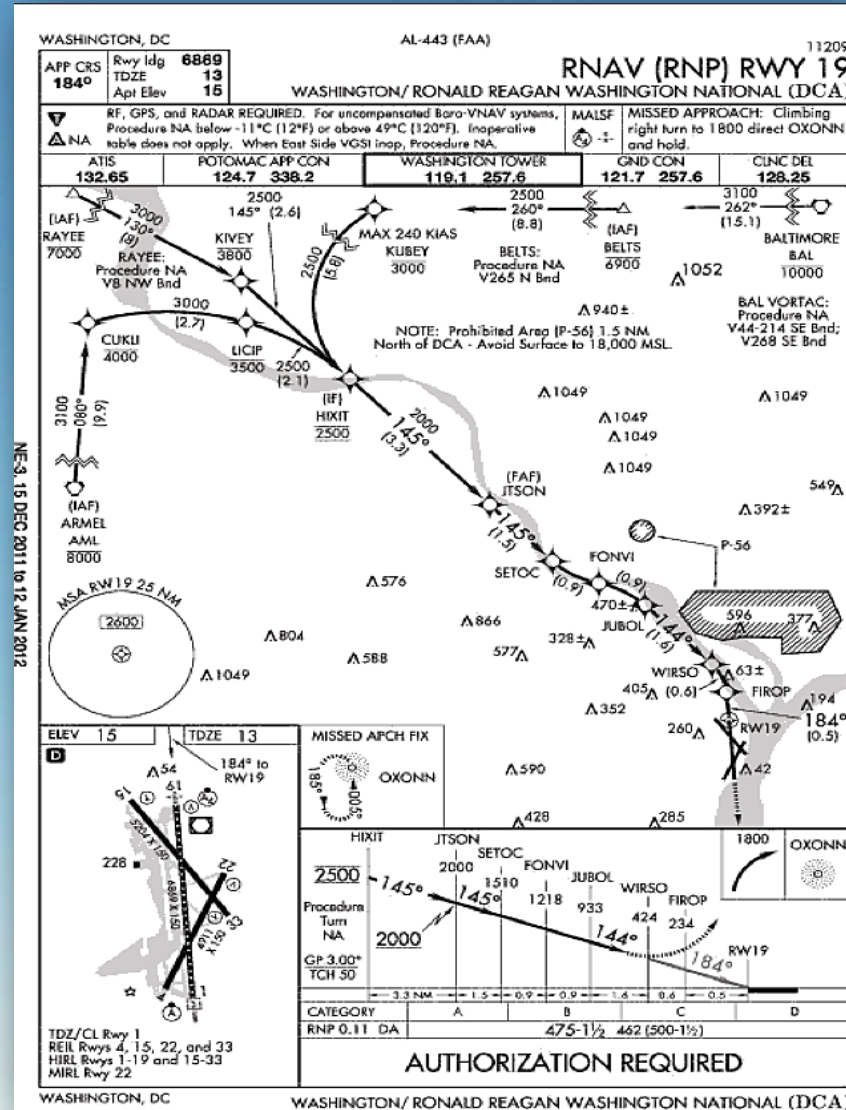
- As agreed by airframe manufacturer

- 1 Autopilot and auto throttle.....Disconnect**
- 2 a) Nose down pitch control.....Apply until stall warning is eliminated**  
**b) Nose down pitch trim.....As Needed**
- 3 Bank.....Wings Level**
- 4 Thrust .....As Needed**
- 5 Speed brakes/Spoilers.....Retract**
- 6 Return to the desired flight path.**



# Simulator Familiarization

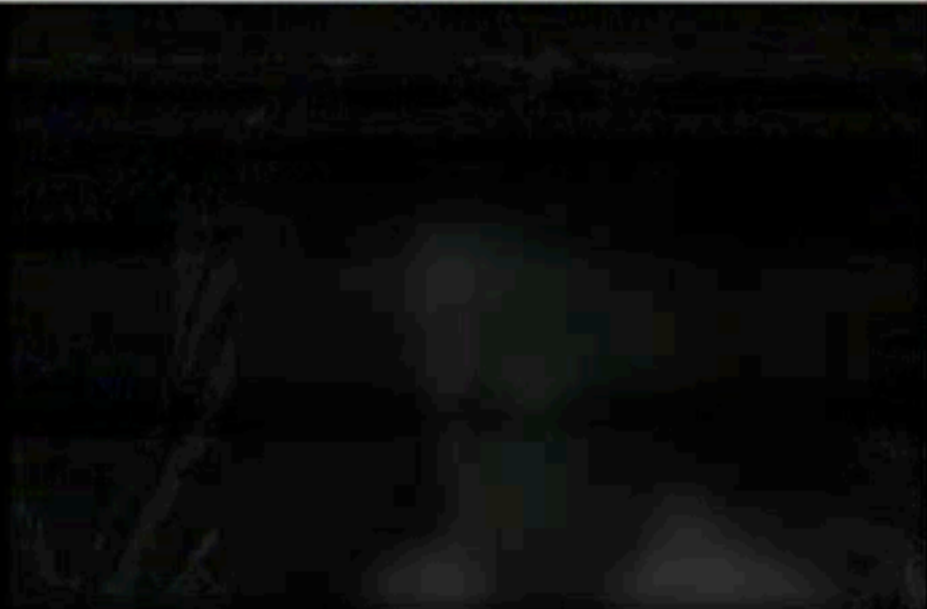
- Each pilot told to fly this approach to Washington National Airport
- Good weather, except for possible thunderstorm at holding point
- Pilots expected a “diversion” (missed approach)



# Successful recovery



# Problematic stall recovery



# Results

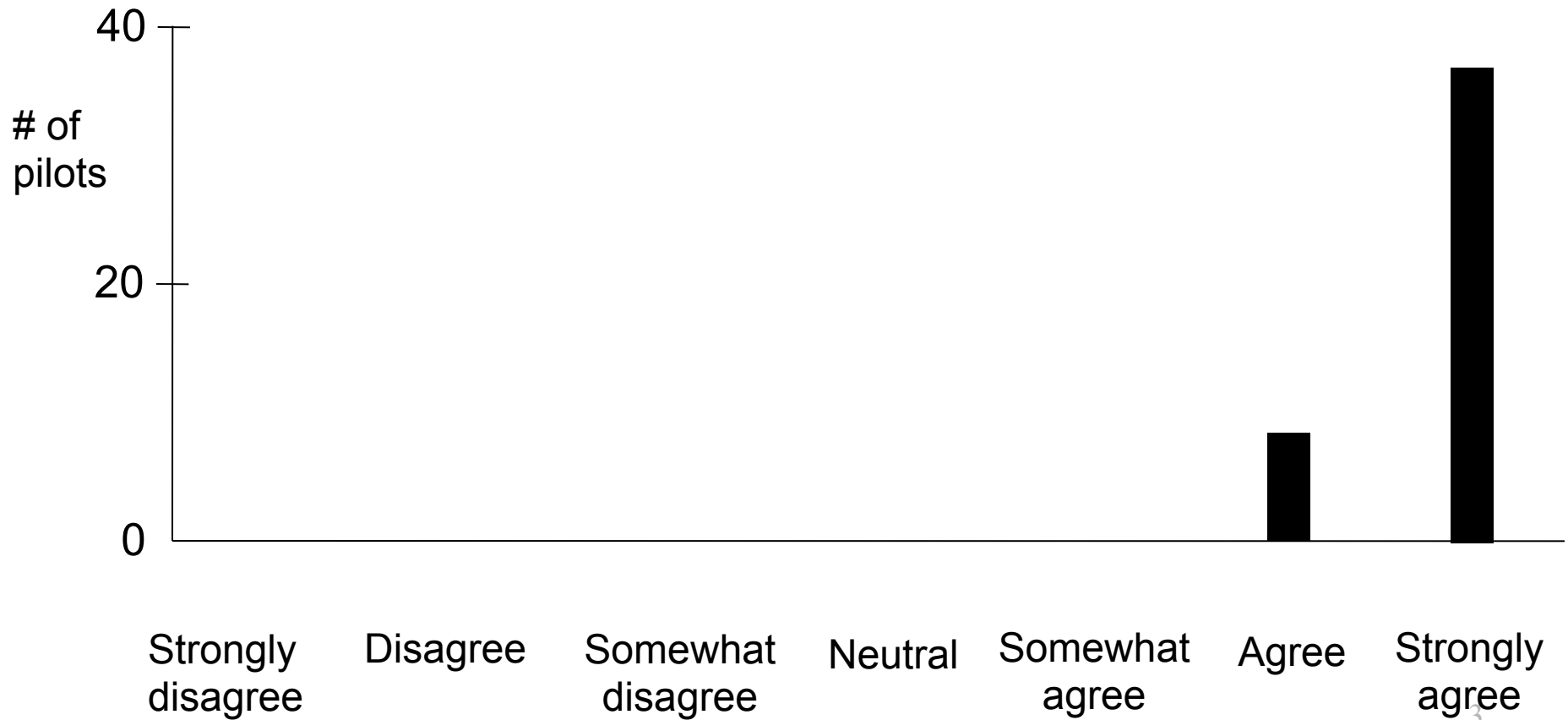
- Only 22% of pilots applied correct procedure
  - 10 out of 45 applied stall recovery procedure correctly when surprised
    - 19 out of 45 applied nose-down pitch until stall warning was eliminated
    - 20 out of 45 applied nose-down pitch before trying to control bank
    - 23 out of 45 stayed off the pedals ( < 1 inch)
    - 34 out of 45 applied thrust as needed per template\*
- No one crashed in this challenging scenario





# Questionnaire Results

“I was surprised by that event”







# Conclusion

- With proper training put into practice through a properly-qualified program, including
  - exposure to the prevention and recovery environment
  - integration of knowledge and skills
  - proper instruction
  - appreciation of psychophysical limits
- Through a GRADUATED IMPLEMENTATION, we can achieve the main learning objectives for LOC-I

# Main Learning Objective



**KEEP  
CALM  
IT'S ONLY AN  
UPSET**

# African Proverb

**If we ignore reality, we will learn through accidents**



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