The contribution of pilots to resilience in normal operations: A survey approach.

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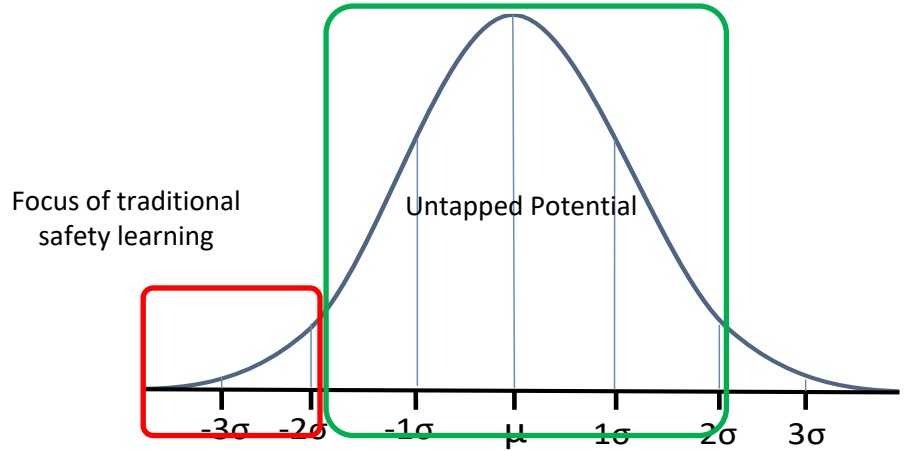
The human contribution



Resilience

- System resilience

  ‘The intrinsic ability of a system to adjust its functioning, prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions’ Hollnagel, 2011

The wheel of perturbation

The human contribution to system resilience

Hollnagel's Resilience Analysis Grid

- **Anticipate**
  Anticipate perturbations
- **Monitor**
  Search for signs of actual or potential perturbations
- **Respond**
  Respond to perturbations
- **Learn**
  Continually increase knowledge and skills

The wheel of perturbation

How can we study pilots' contribution to system resilience?

- Observations
- Interviews
- Focus groups
- Simulations
- Flight data analysis
- Could a survey be useful?
  - Research tool, safety management tool

Examples of existing programs

American Airlines - Learning and Improvement Team (LIT)
Japan Airlines - Resilience Operations Monitoring (ROM)
Southwest - Safety and Learning Advancement Team (SLAT)
Cathay Pacific - Operational Learning Review (OLR)
NATS - Day-to-Day Safety Observation (D2D)
ENAIRE - Normal operations monitoring

Resilience surveys

Van der Beek & Schraagen (2015) ADAPTER Scale, 156 questions

There is always someone in my team who makes us think about how we do our work.

1= strongly disagree …… 5= strongly agree

Hollnagel, (2011) Resilience Analysis Grid, 79 proposed questions

To what extent is risk awareness part of the organizational culture?

Excellent … Satisfactory … Acceptable … Unacceptable … Deficient … Missing

System Resilience Potential Scale

We are interested in understanding how your "work system" (i.e., the resources, tools, equipment, procedures, and training you are provide) support your ability to achieve, reprioritize, or redirect your goals and actions to sustain safe and successful operations.

For your "work system," please tell us about the AVAILABILITY and EFFECTIVENESS of each of the policies/procedures listed below:

	My work system includes policies or procedures that support my ability to:	Yes/No	If YES, how effective is this support? (1= very poor, 5=very good)				
1	Detect and track anomalies, surprises, and inconsistencies.	Y / N	1	2	3	4	5
2	Evaluate the plausibility of anomalies, surprises, and inconsistencies.	Y / N	1	2	3	4	5
3	Evaluate data quality/integrity.	Y / N	1	2	3	4	5
4	Use anomalies, surprises, and inconsistences to form new understandings.	Y / N	1	2	3	4	5
5	Compare different understandings or perspectives.	Y / N	1	2	3	4	5
6	Formulate new goals or reprioritize existing goals.	Y / N	1	2	3	4	5

Derived from Hoffman & Hancock (2017).

Holbrook et al. (2019) Controller Questionnaire, 17 questions

In your job as Air Traffic Controller, how often do you exhibit the following behaviors?

f) Providing team support and adaptive capacity as required

Less than Once per Month	At Least Once Per Month	At Least Once Per Every 2 Weeks	At Least Once per Week	At Least Once Daily	At Least Once Per Session	More Than Once Per Session

Our survey

- Individual human contribution, *not organizational level*
- Pilot behaviors, *not attitudes*
- Behavior that goes beyond SOPs
- Top of descent to landing
  - (ATC interactions, STARS)
- Most recent flight
- 49 items

	Check-the-box questions	Agreement rating scales	Two-part questions	Free text
Perturbations				
Anticipate				
Monitor				
Respond				
Learn				

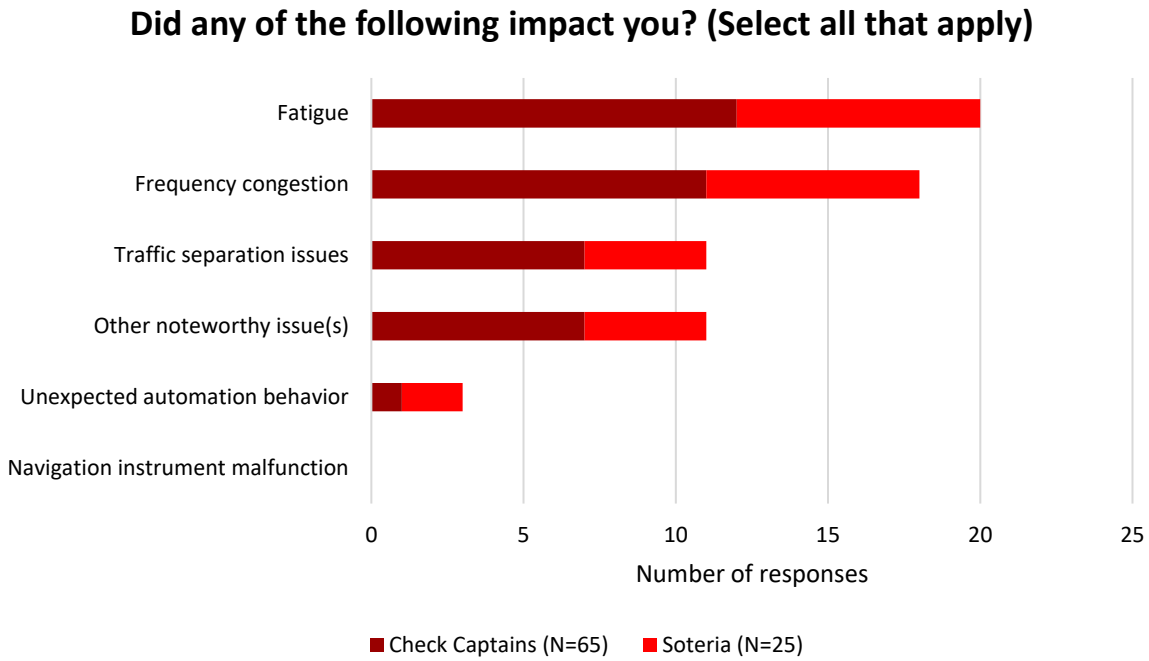
Participants

- SOTERIA (N=25)
- B 737
- System-wide Safety Operations and Technologies for Enabling Resilient In-Time Assurance
- Paid participants: 96% response rate

- Check Captains (N=65)
- B 737
- Unpaid participants: ~ 22% response rate

Perturbations

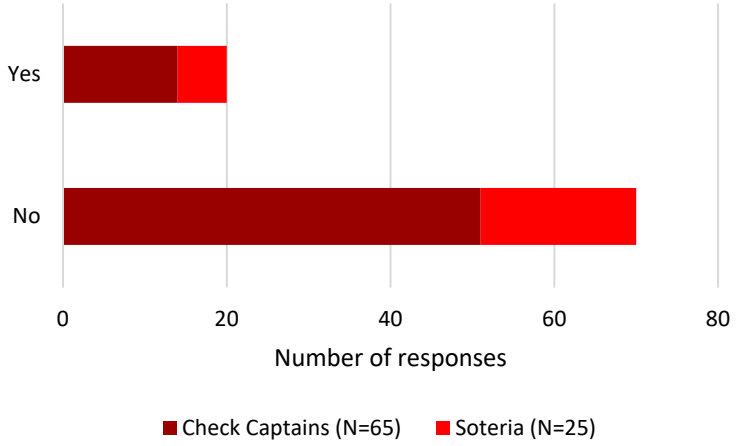
Check-the-box question



Perturbations

2 part with free text follow-up

Part 1, In your last leg, did you encounter something that made this NOT a textbook flight, and you needed to think deeper than just following SOPs to successfully complete the flight?

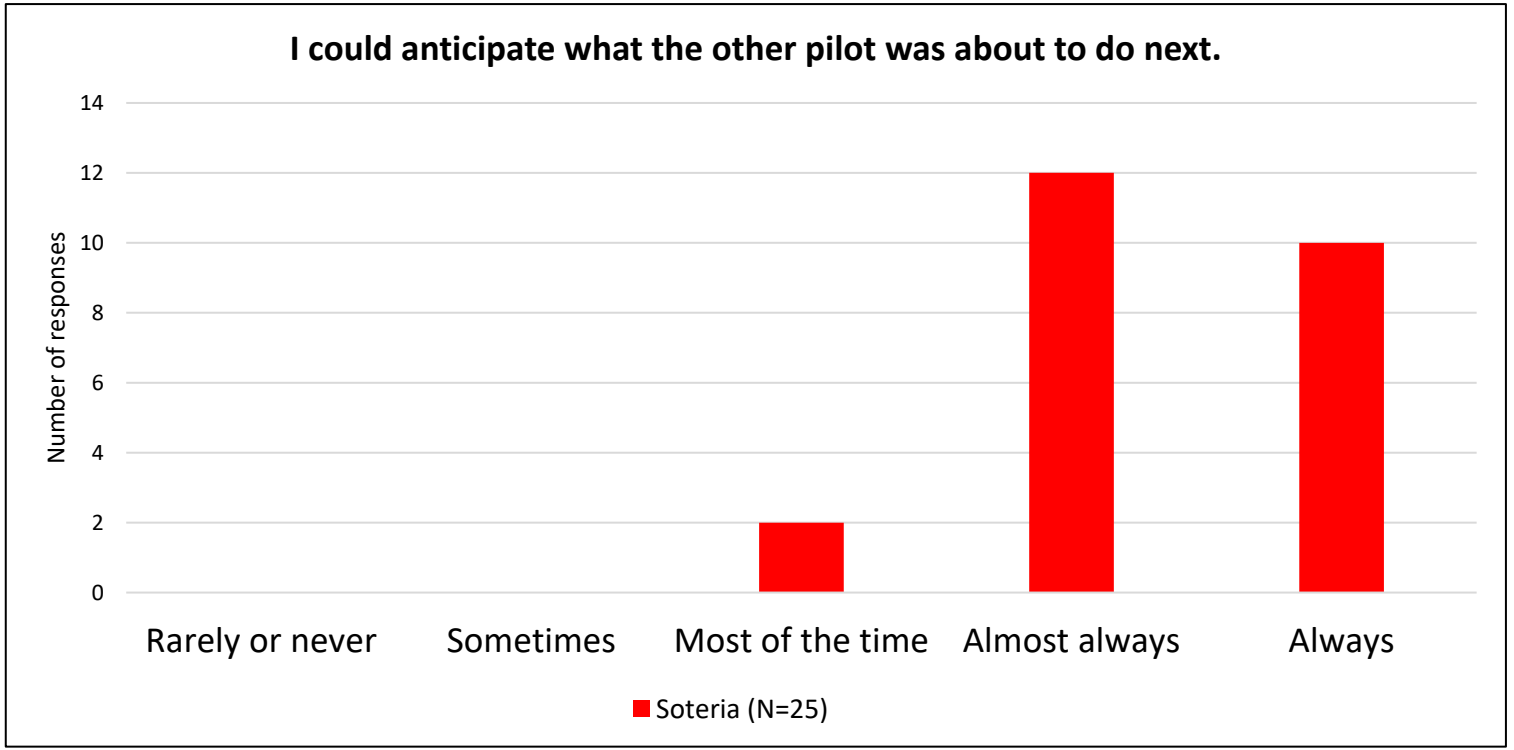


Part 2, What did you encounter, and what did you do?

- “Distraction from the preceding aircraft not clearing the runway.”
- “Late runway change.”
- “I was stable on the ILS and configured to flaps 10. ATC then asked us to speed up 10 knots and increase descent rate to 3000 ft. I had to retract flaps to 5 then disconnect APPR mode.”
- “I asked the inbound flight attendants about turbulence, and didn’t expect their response.”

Anticipation

Rating scale



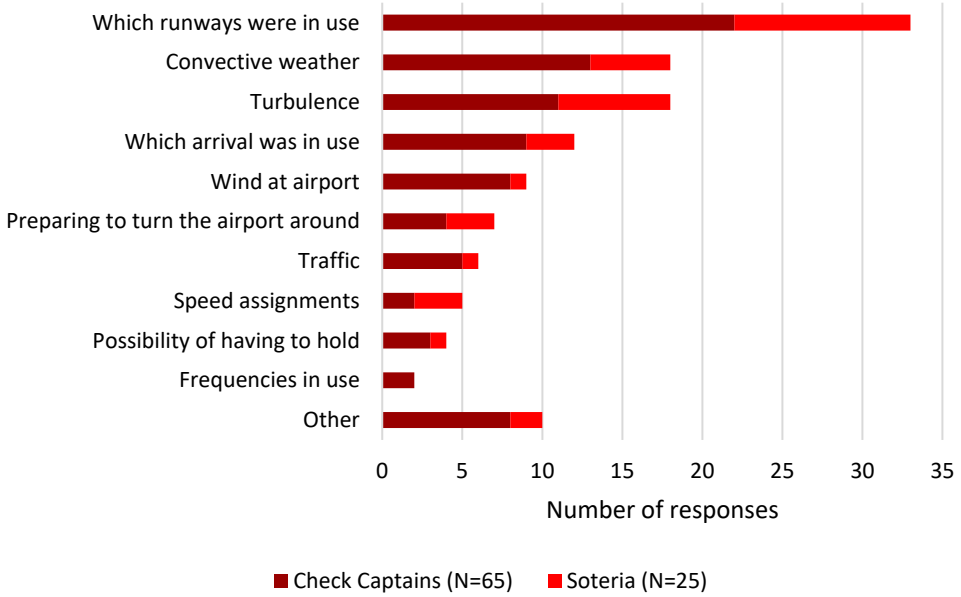
Monitoring and Anticipation

2 part with check-the-box follow-up

Part 1
Did you gain any useful information by listening to the traffic ahead of you?

Yes: 64%
Listened but did not gain information: 36%
Did not listen: 0%

Part 2
What useful information did you gain? (Select all that apply)



Monitoring

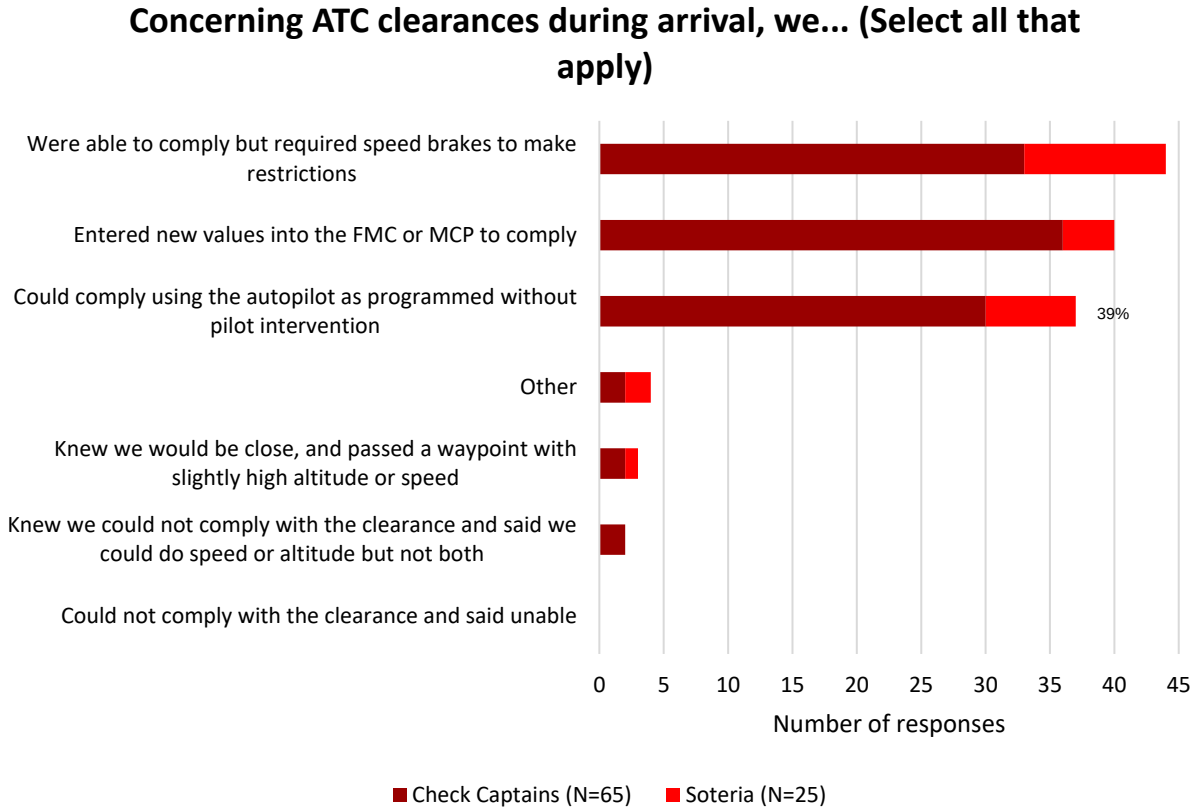
Free text

Over your career, what good strategies, practices, or rules of thumb have you discovered from operational experience that could help CAs or FOs improve monitoring on the flight deck?
(29 out of 65 Check Captains provided comments)

- 3:1 still works! Use your brain to assess how automation is doing.
- Talk and game play potential situations that might occur throughout the flight. Ask the FO or new CA what would they do?
- Think ahead on what ATC might want. Fly the aircraft with these restrictions in mind.
- Stay ahead of aircraft and think about what is coming next. Constantly check to see if we are on path via multiple methods.

Respond

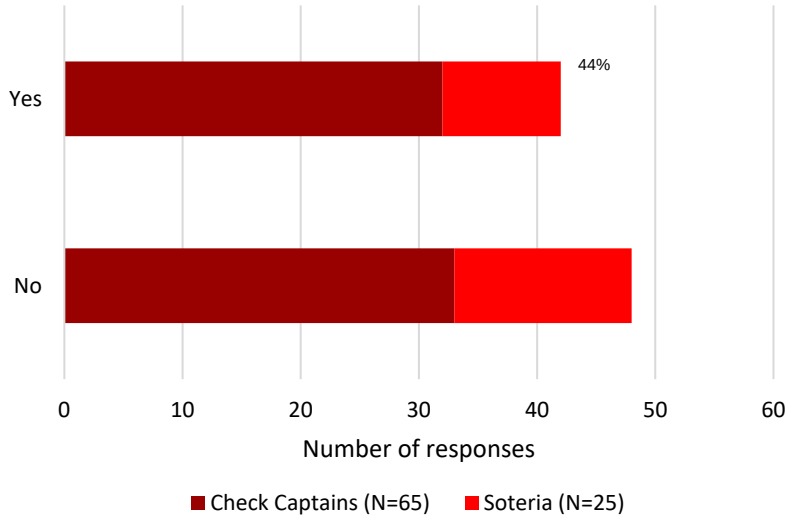
Check-the-box question



Learn

2 Part with free text follow-up

Part 1, In your last leg, did you learn something that might help you on future flights?



Part 2, What did you learn?

Crew communication

"To talk with each other and bring up how they will fly the approach. What is the plan and what to do if it doesn't work out."

Operation of a technical feature

"We discussed weather radar symbols, and it refreshed my knowledge."

Aircraft performance characteristic

"Energy management when an RJ in front slows down too early - can get you crunched for spacing."

Air Traffic Control

"Which arrival they like to use on the directions that we were going from."

Summing up: Lessons about system resilience

- Pilots reported that ~ 21% of flights were NOT “textbook”
- Pilots are regularly anticipating and adapting to challenges
  - But human adaptability can enable bad designs and bad procedures to persist
- Pilots reported frequent learning from their flight experiences

Summing up: Using a survey to explore resilience

- Closed questions
  - May be most useful to identify nature and frequency of perturbations in normal operations
  - Rating scales may be less useful for exploring pilot actions
    - Limited range of options, leading questions, desirability bias
- Accuracy of memories
  - Discrepancies, are both pilots flying the same leg?
  - Accessibility to conscious awareness?
- Are some respondents echoing concepts from CRM or HF training?
- Can we measure resilience?
  - Survey approach may be most useful a discussion prompts rather than measurement tools

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References

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