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AUTOMATION SURPRISE IN AIR TRAFFIC CONTROL: CAUSES, FREQUENCY, AND SAFETY IMPLICATIONS

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Automated vs Manual

Today

a folding chair, drinking water, and a pad for taking notes. (National Archives

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Automation Surprise

- ..when the automation behaves in a manner that is different from what the operator is expecting (Palmer 1995)
- Automation Startle can be considered an automatic, physiological response triggered by a sudden event that contradicts the operator's expectations. (Martin 2012)
- AS can be seen as a cognitive-emotional response to something unexpected, resulting from a discrepancy between expectations and perceptions of the environment (Landman 2017)
- Leading to higher workload and inefficient operations
  - What is it doing? Why is it doing that? What will it do next?
  - Loss of Situational Awareness (M. Endsley: perception, comprehension, prognosis)

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Automation Startle

✓ https://youtu.be/fQNaocQWDsY

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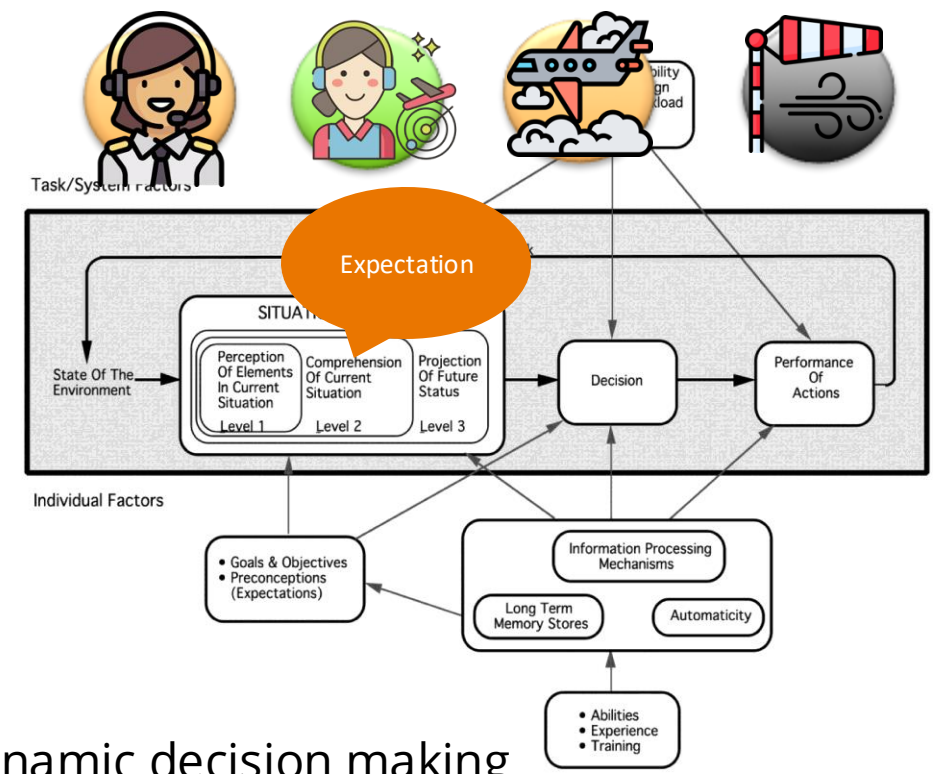
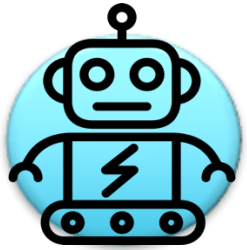
Situation Awareness





Model of SA in dynamic decision making (Endsley, 1995)

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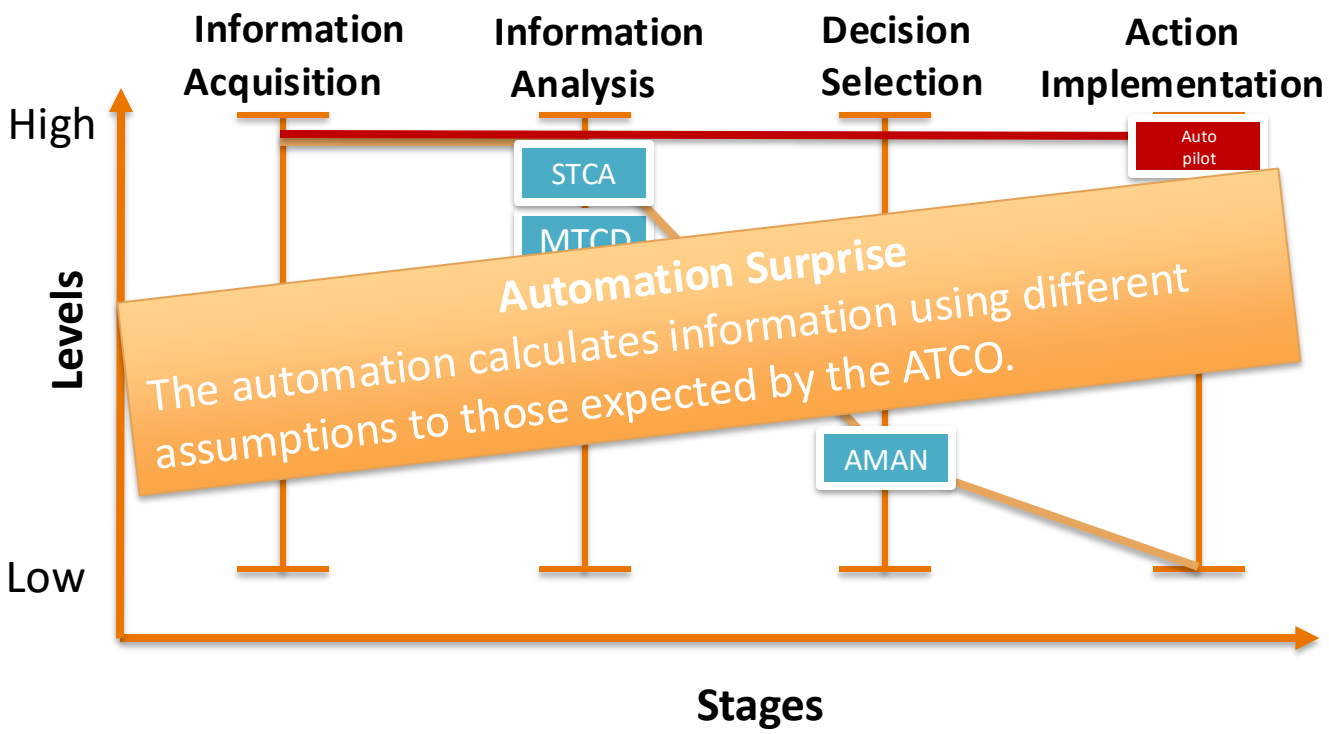
AS for low level automation work environment



(Parasuraman et al. ,2000/ Save et al., 2012)

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The Hypothesis

- ✓ Is there a similar prevalence of AS for information systems
  - Information acquisition and analysis
- ✓ Low level automated work environment
  - Medium-Term Conflict Detection (MTCD),
  - Short-Term Conflict Alert (STCA),
  - Area Proximity Warning (APW),
  - Minimum Safety Altitude Warning (MSAW) and
  - System Coordination (SYSCO).
  - Separation Management Tool (“Septool”)

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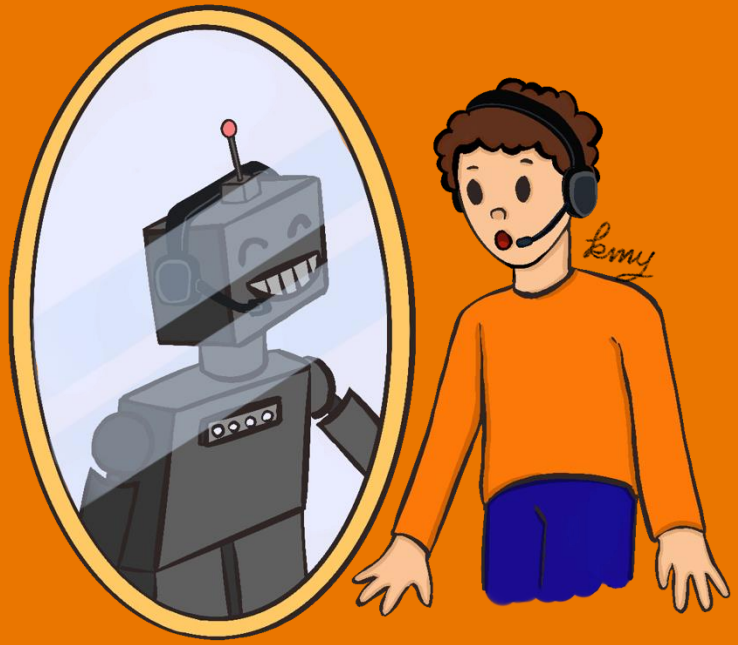
AUTOMATION SURPRISE THE SURVEY



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A Retrospective Survey

- ✓ Baseline from Flight Deck Operations by De Boer & Hurts 2017
  - 200 Dutch Pilots
  - Reportable AS occurrences are estimated to occur only once every 1–3 years per pilot.
- ✓ 47 ATCOs from ATCC Malmö and Stockholm
  - Contributing Factors
  - Systems used
  - Situational Context
  - Temporal Distribution
- ✓ identifying the conceptual differences
- ✓ factors contributing to the cause and prevention of AS

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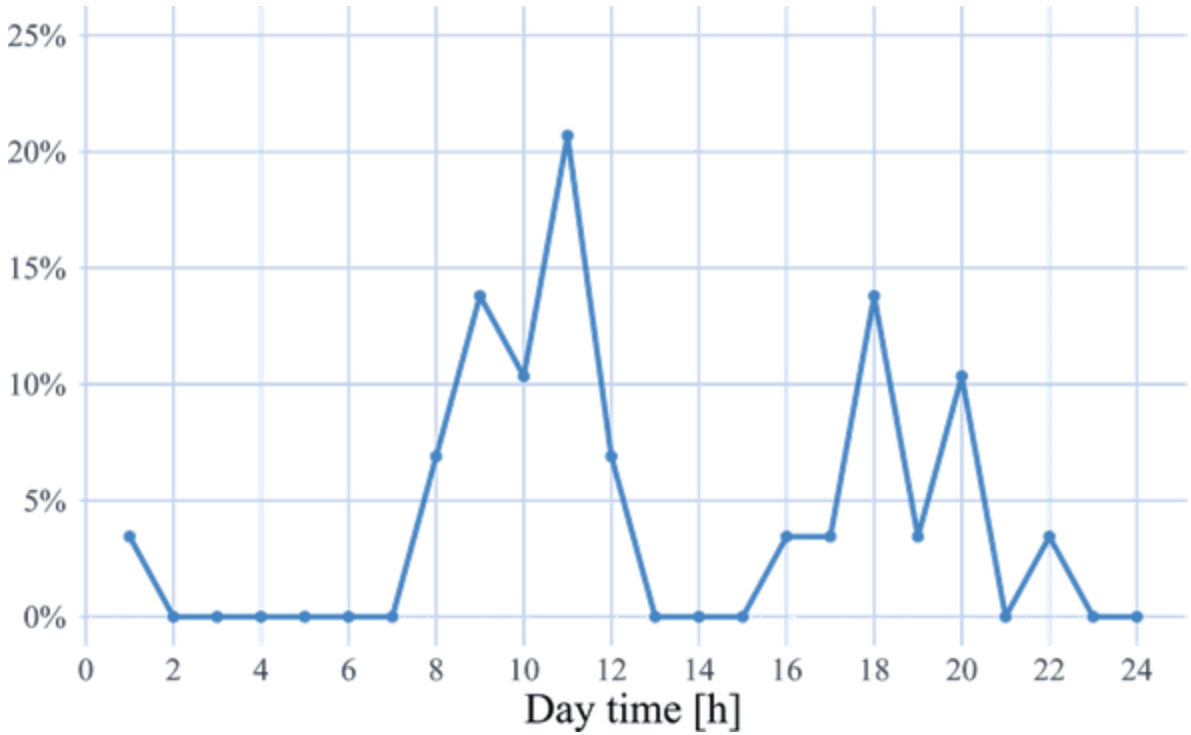
Temporal Distribution over Day



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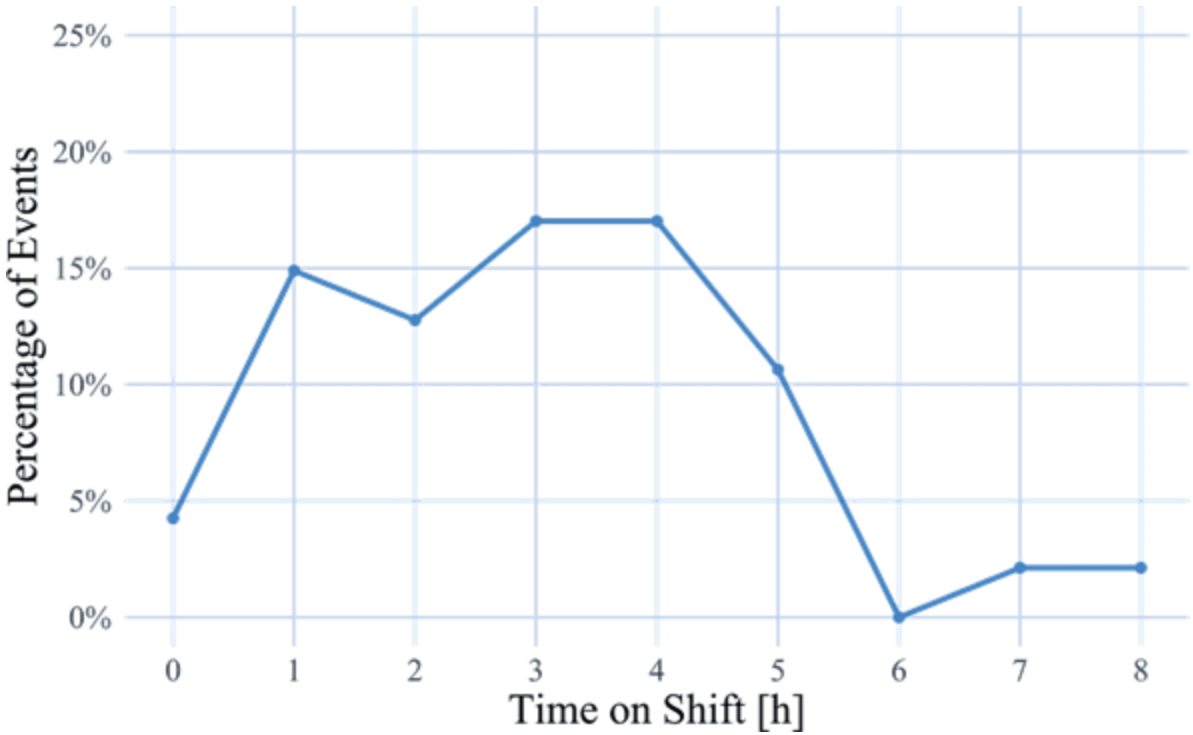
Temporal Distribution over Shift



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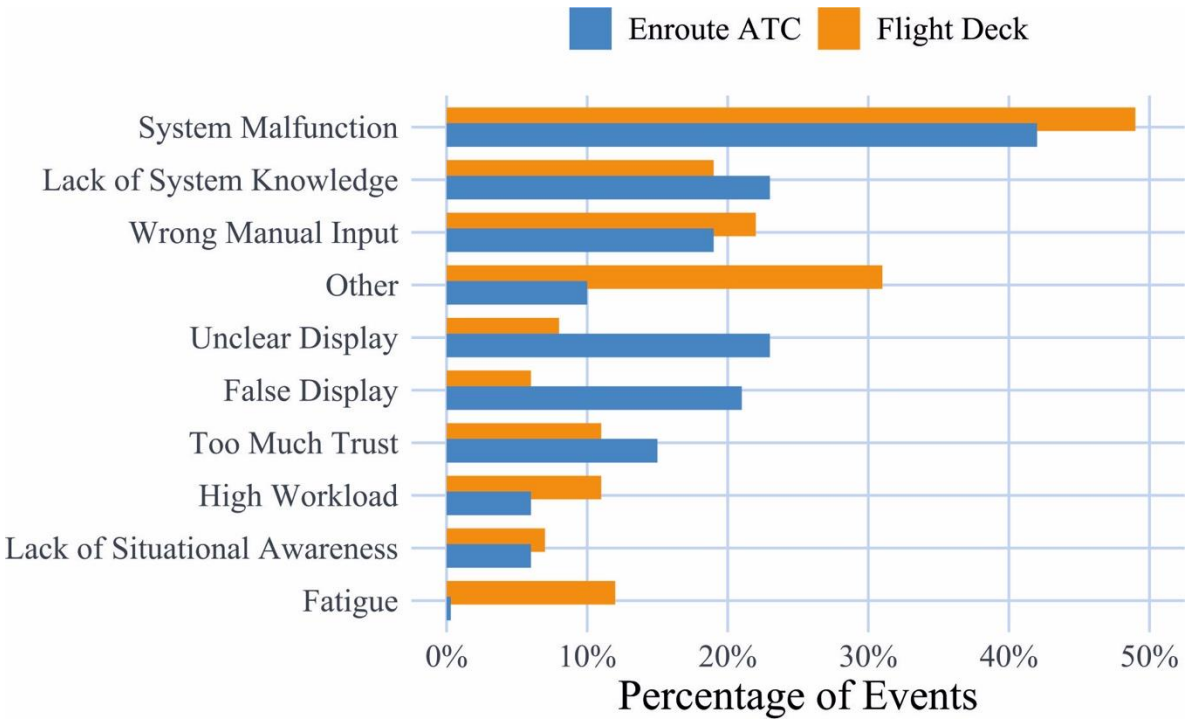
Contributing Factors



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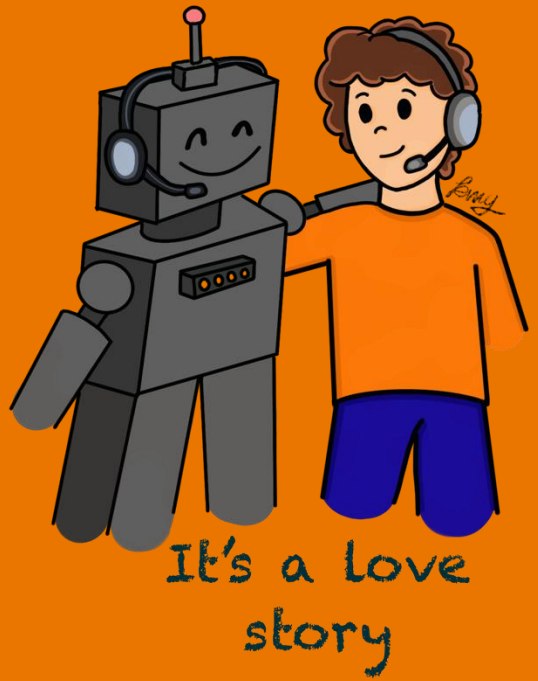
Poster EAAP 24

Master Thesis
Matthis Fritz

A SAFETY APPROACH TO AS



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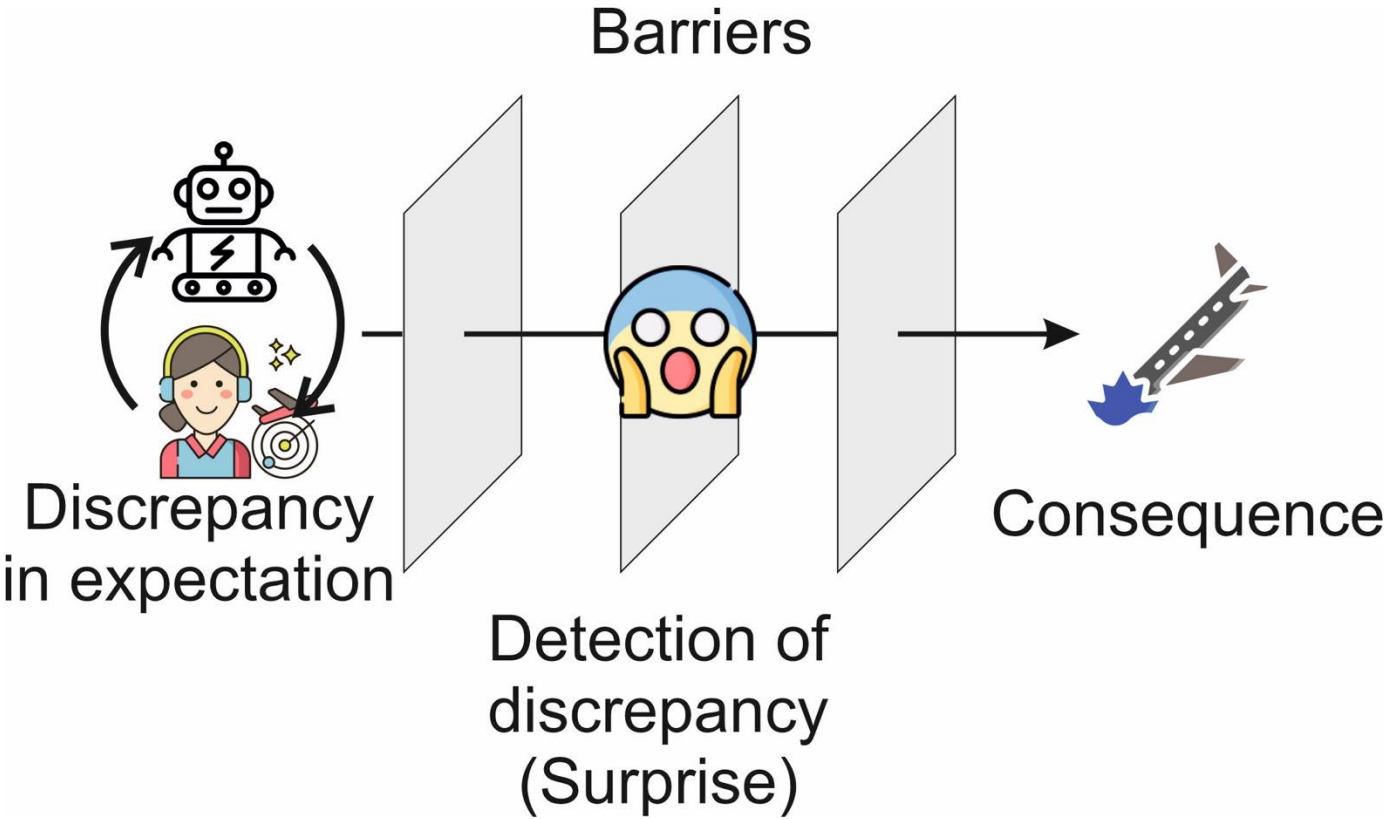
Discrepancy in Expectation



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Unclear/False Display

- ✓ 80% MTCD, 20% STCA

From the open comments field

  - "MTCD didn't calculate as I had expected" or
  - "MTCD is the function that most often produces surprises; it didn't indicate a conflict, then suddenly it did, and then it didn't again."

- ✓ Information Systems can have many assumptions (spatial boundaries and trajectory predictions)
- ✓ Safety Effect -> **Mistrust**

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Enroute ATC vs Flight Deck

Enroute ATC	Flight Deck
Low in emotional salience Form of expectation violation, manifesting as curiosity, astonishment, mild irritation, or transient confusion	From low to high emotional salience (up to startle), (Landman 2017)
Information based detection	Action based detection
On average, 0.6 AS events occurred per shift, with 4% of ATCOs associating AS with a certain risk for loss-of-separation.	One AS event every 2.6 months on average for all respondents.

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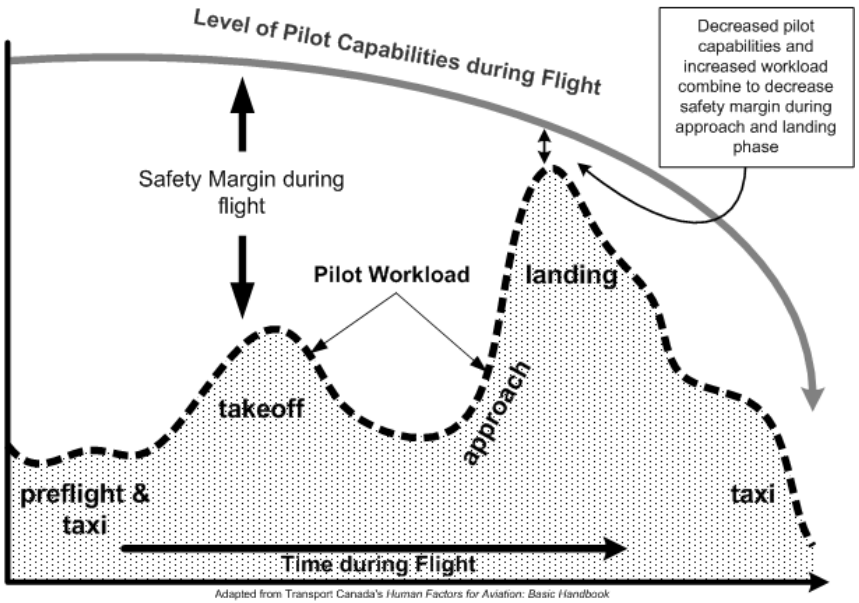
Fatigue and Workload

- ✓ Flight Deck
  - Workload and fatigue more prevalent
- ✓ En-route ATCOs
  - alternate duty,
  - rest hourly and
  - have the option to call for assistance in case of overload work conditions.



Adapted from Transport Canada's *Human Factors for Aviation: Basic Handbook*

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Conclusion

- ✓ AS is prevalent in Enroute ATC
- ✓ Action-based AS in the flight deck is considered more critical because fewer barriers may remain, significantly reducing the response time to recovery.
- ✓ Information-related AS (common in ATC),
  - where surprise results from misinterpreted or misleading information
  - Incorrect assumptions in calculating information are foolish because they could appear plausible to the operator without further questioning
- ✓ severity of each AS was judged to be significantly lower in ATC

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Thank you

Lothar Meyer, Matthis Fritz, Maximilian Peukert, Lars Danielson, Christian Bjursten, Eivind Martinsen
Featuring Prof. Sebastian Panasch

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