Do we Understand the Risks we are Introducing?

ABC
September 16th, 2025

Human Systems integration division

Immanuel Barshi, NASA Ames Research Center

80% of accidents are due to human error!

(Bobbi Wells, 2025)

"To fast-forward to the safest possible operational state for vertical takeoff and landing vehicles, network operators will be interested in the path that realizes full autonomy as quickly as possible." (Uber, 2016)

Human error has been implicated in up to 80% of accidents in civil and military aviation!

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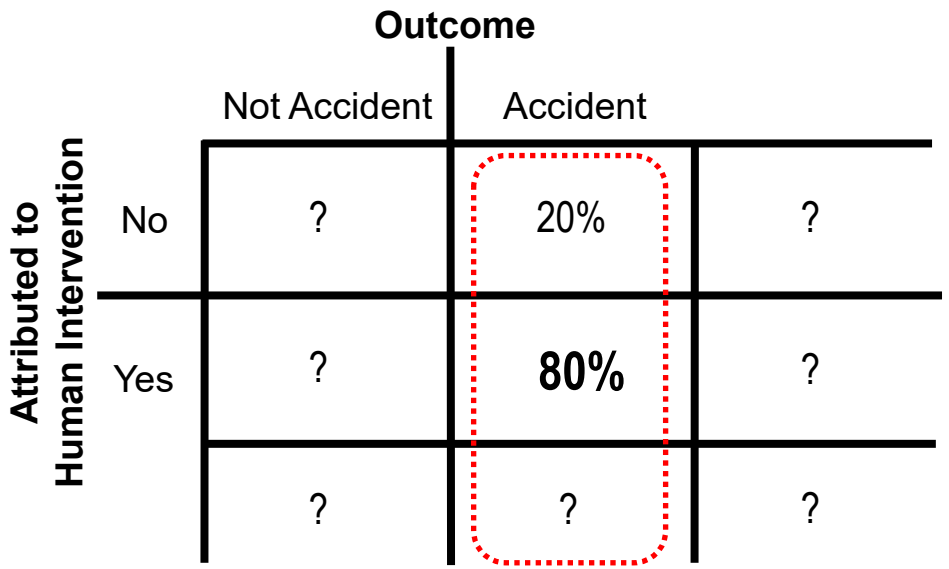

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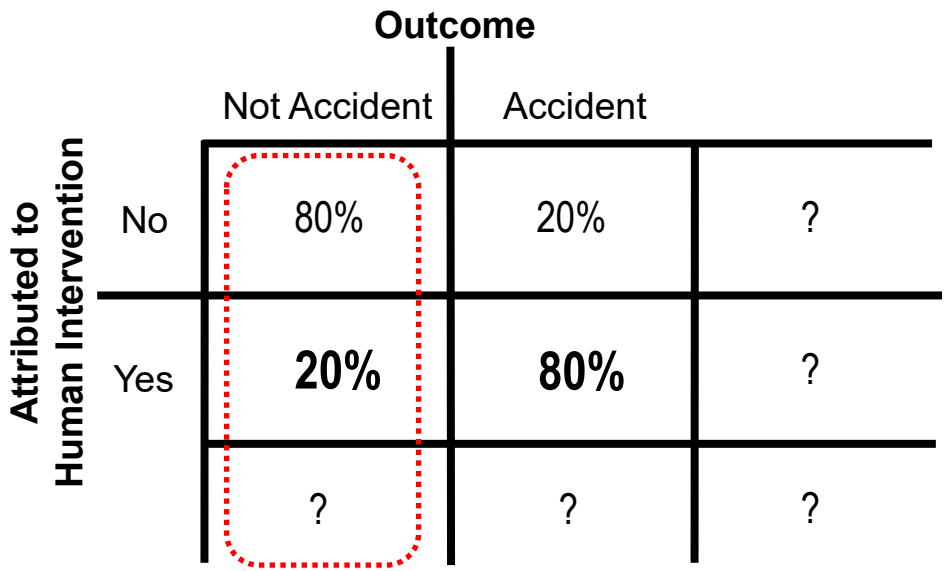

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  - 244 million departures
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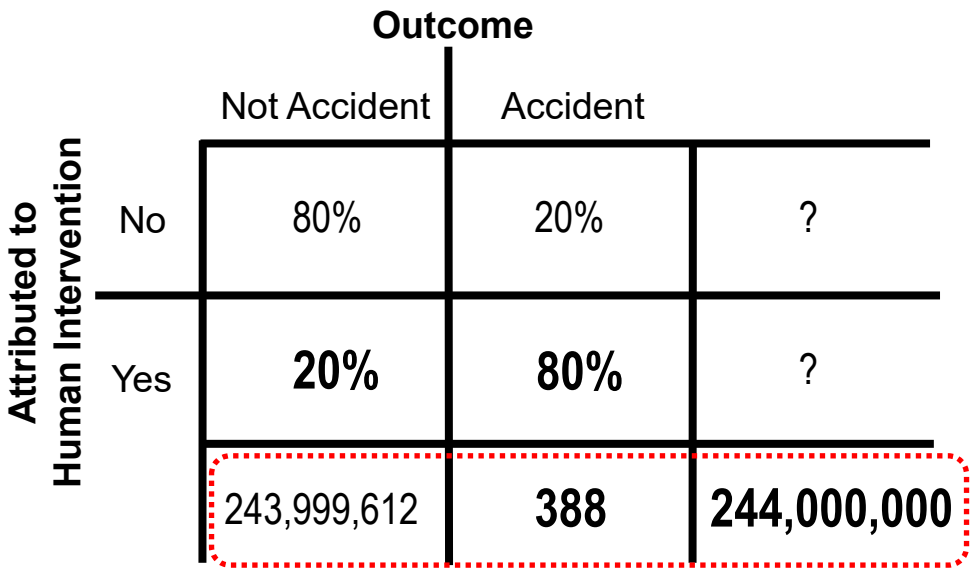

(1) Weigmann & Shappell, 2003; (2) PARC/CAST, 2013; (3) Boeing, 2017

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Attributed to Human Intervention	Outcome: Not Accident	Outcome: Accident	
No	195,199,690	78	195,199,768
Yes	48,799,922	310	48,800,232
	243,999,612	388	244,000,000

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Pilots *Produce* Safety Far More Often than They *Reduce* It

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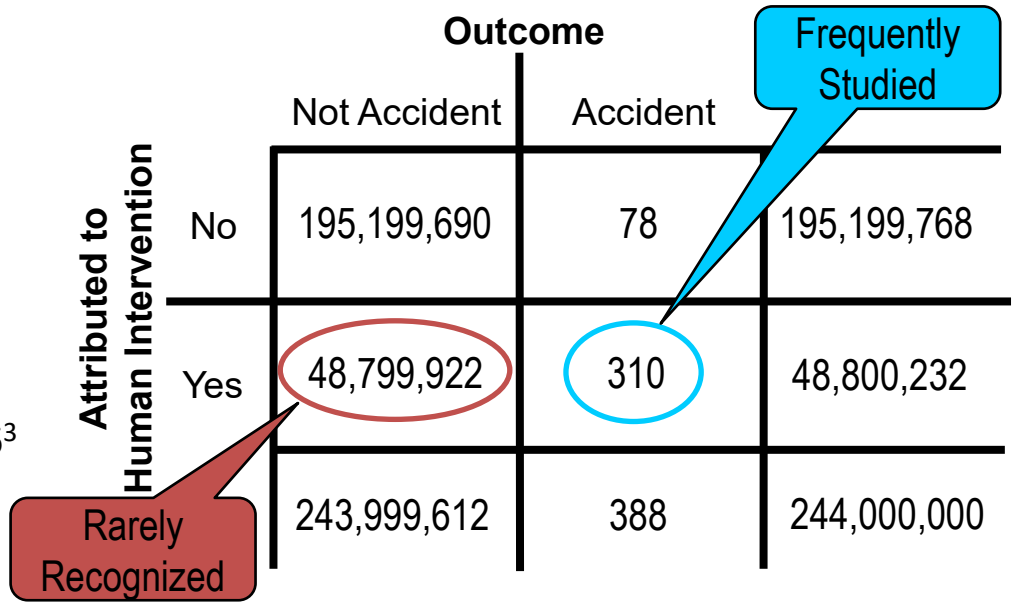

Learn more: Holbrook, J. (2021). Exploring methods to collect and analyze data on human contributions to aviation safety. In *Proceedings of the 2021 International Symposium on Aviation Psychology.* https://aviation-psychology.org/wp-content/uploads/2021/05/ISAP_2021_Proceedings_FINAL.pdf

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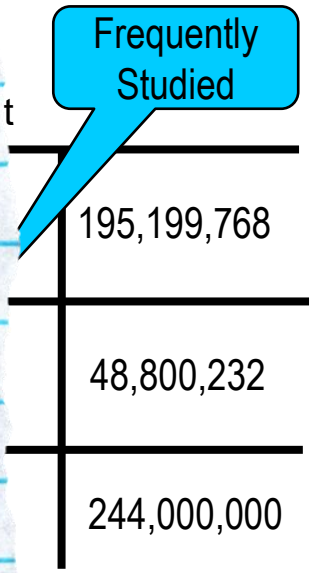

Revisiting Our Assumptions on Human Performance

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  Pilots intervene in various ways on 100% of flights!

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$$\frac{\text{(All non-accidents)}\ 243{,}999{,}612}{388\ \text{(All accidents)}} = 628{,}865$$

Human capabilities keep flights safe more than **628,865** times for every time that a human limitation contributes to an accident!

This estimate is more indicative of operational realities!

Consequences of Focusing on Human Error

- Designs intended to “protect” the system from “error-prone” humans can design *out* the capability for humans to effectively intervene/adapt, which is a far more common behavior than error.

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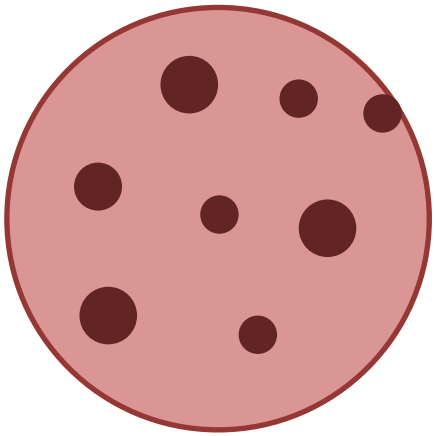
- Designs intended to "protect" the system from "error-prone" humans can design *out* the capability for humans to effectively intervene/adapt, which is a far more common behavior than error.
- Automation levels are only increasing
  - Until automation designers acknowledge and consider that operators can intervene to *cause* safety, every increase in automation adds to the risk of
    - Isolating the operator from the system
    - Limiting the operator's adaptive capacity and capability

Absence of evidence ≠ evidence of absence

A Debatable Claim: *"To fast-forward to the safest possible operational state for vertical takeoff and landing vehicles, network operators will be interested in the path that realizes full autonomy as quickly as possible." (Uber, 2016)*

- When we characterize safety only in terms of errors and failures, we ignore the vast majority of human impacts on the system.
- When policy and design decisions are based only on failure data, they are based on a non-representative sample.

Food for Thought



Suppose we want to understand chocolate chip cookies, because they are desirable, and we want to have more.

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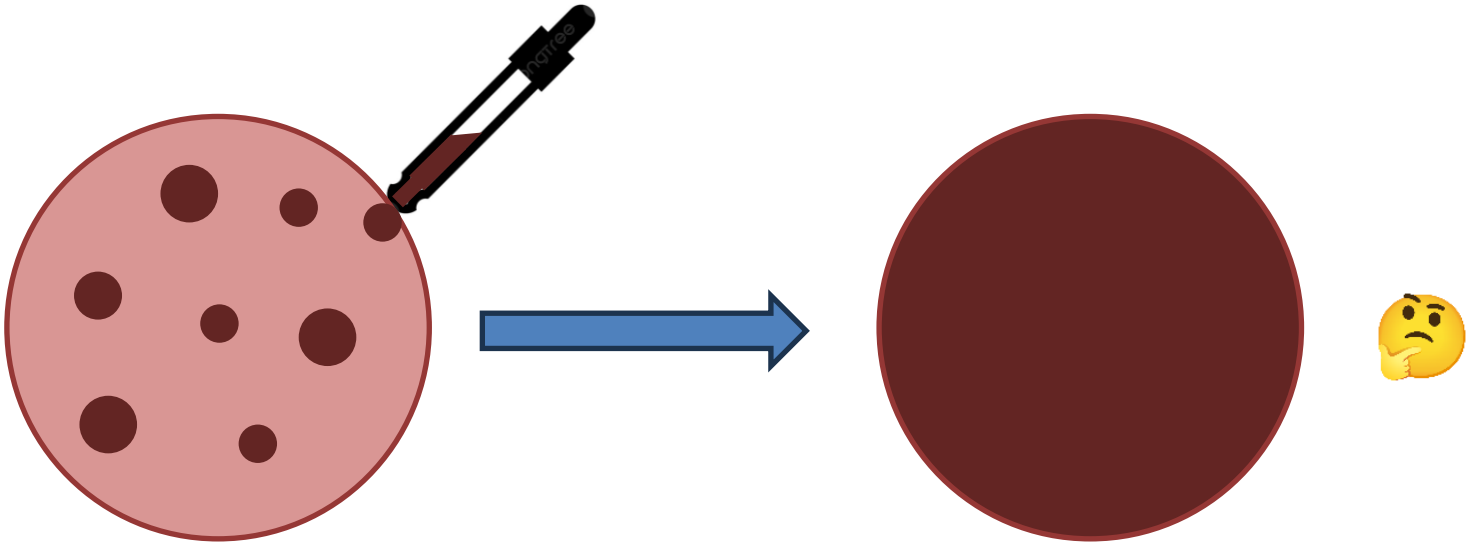

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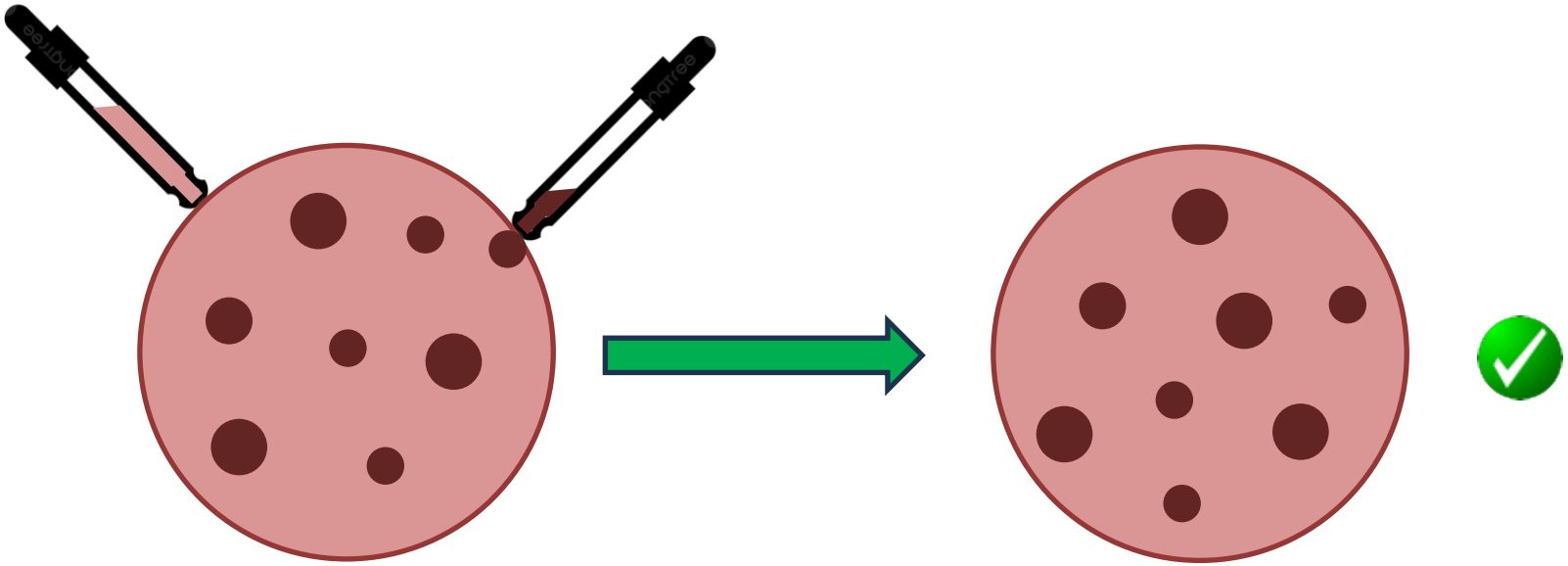

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An operational example

Suppose we want to understand ***safety***,
because it is desirable, and we want to have more.

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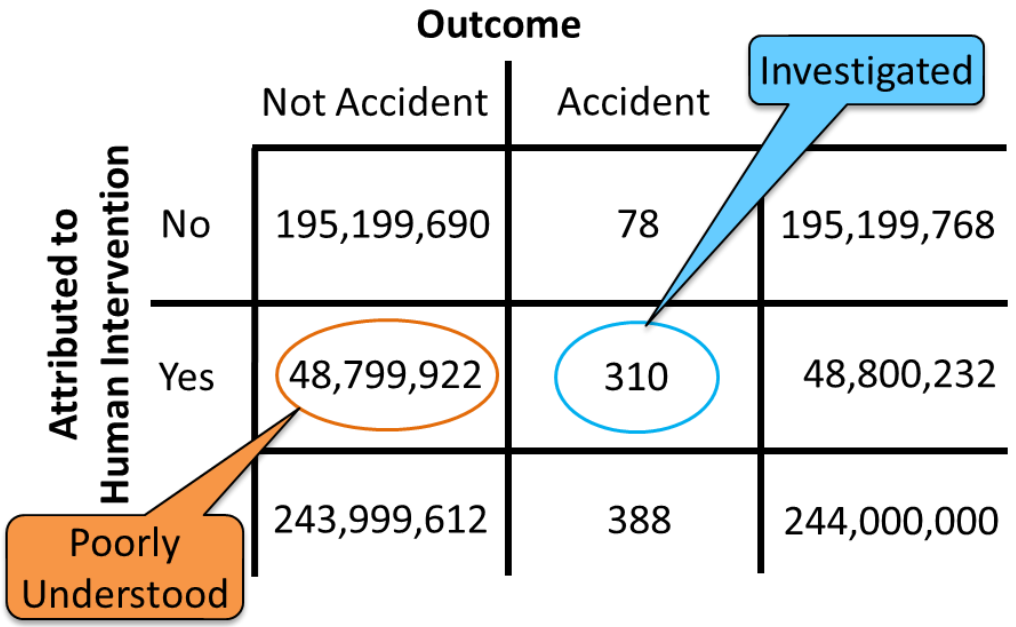

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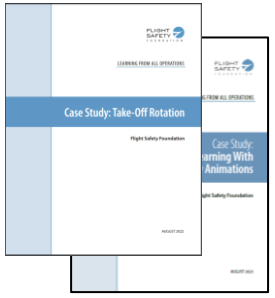
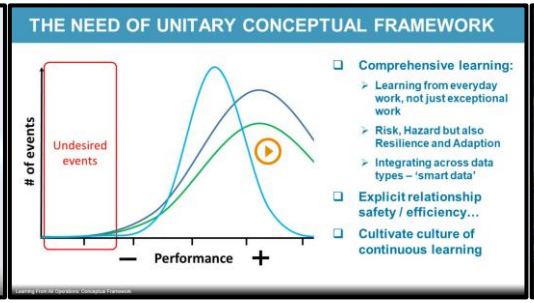
Learning from All Operations: Resources

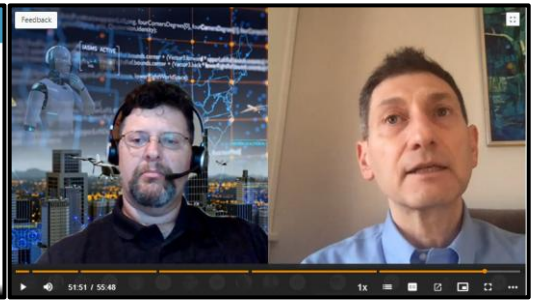
Publications

FLIGHT SAFETY FOUNDATION



https://flightsafety.org/toolkits-resources/learning-from-all-operations/





https://nescacademy.nasa.gov/video/15d835918c84470bbf3177d0c4db65961d

Our thinking affects our policies and designs

- When policy and design decisions are based only on failure data, they are based on a very small sample of non-representative data.
- Without understanding the mechanisms by which people produce safety, any estimate or claim about the predicted safety of autonomous machines is inherently suspect.
- Removing the human demonstrated reliable source of safety-producing behavior without first understanding the capability being removed introduces unknown risks.

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integration division

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