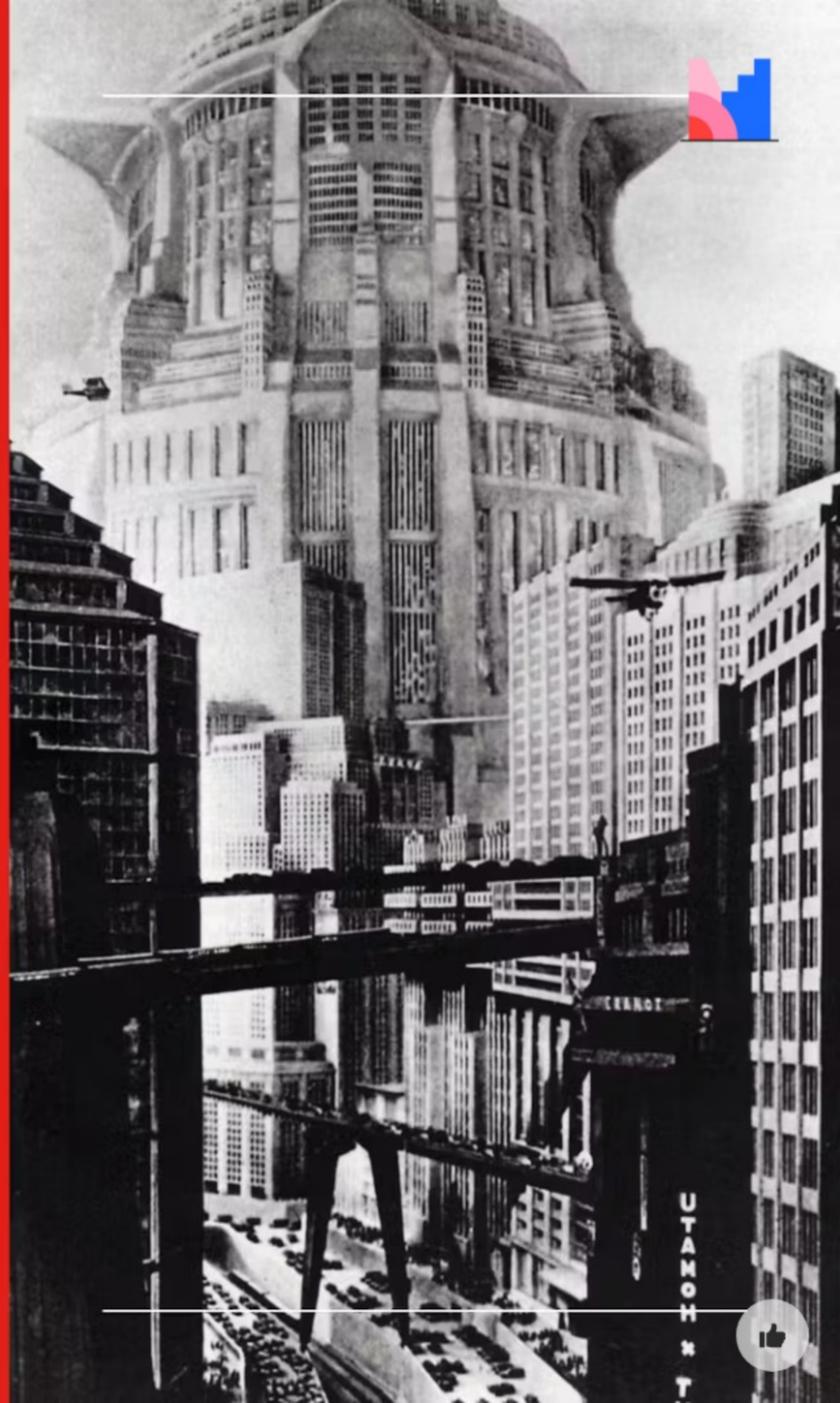
History of safety science: The cognitive revolution

Jop Groeneweg
TU Delft - Leiden University - TNO
KIVI meeting, Delft, 28 October 2024

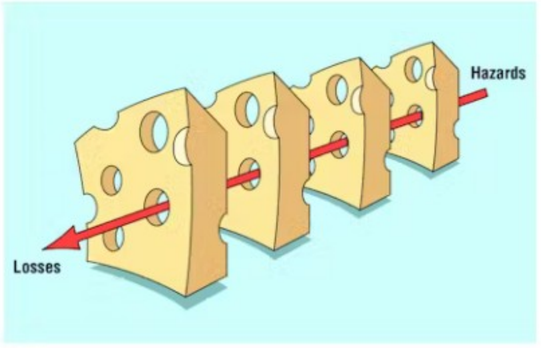


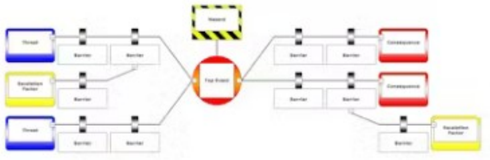
Jop Groeneweg KIVI (28102024)

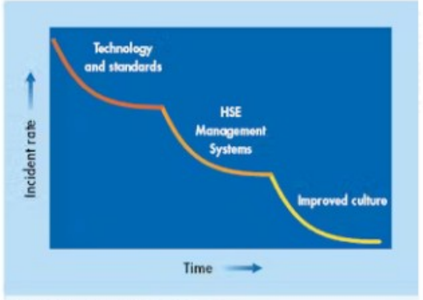
What is the first thing that comes to your mind when you think about 'safety'?

44 responses

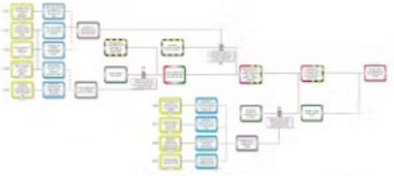
Who am I?

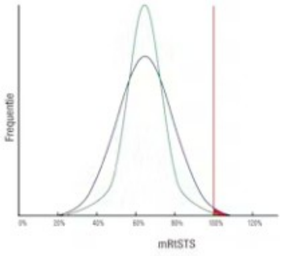






HSE performance over time.



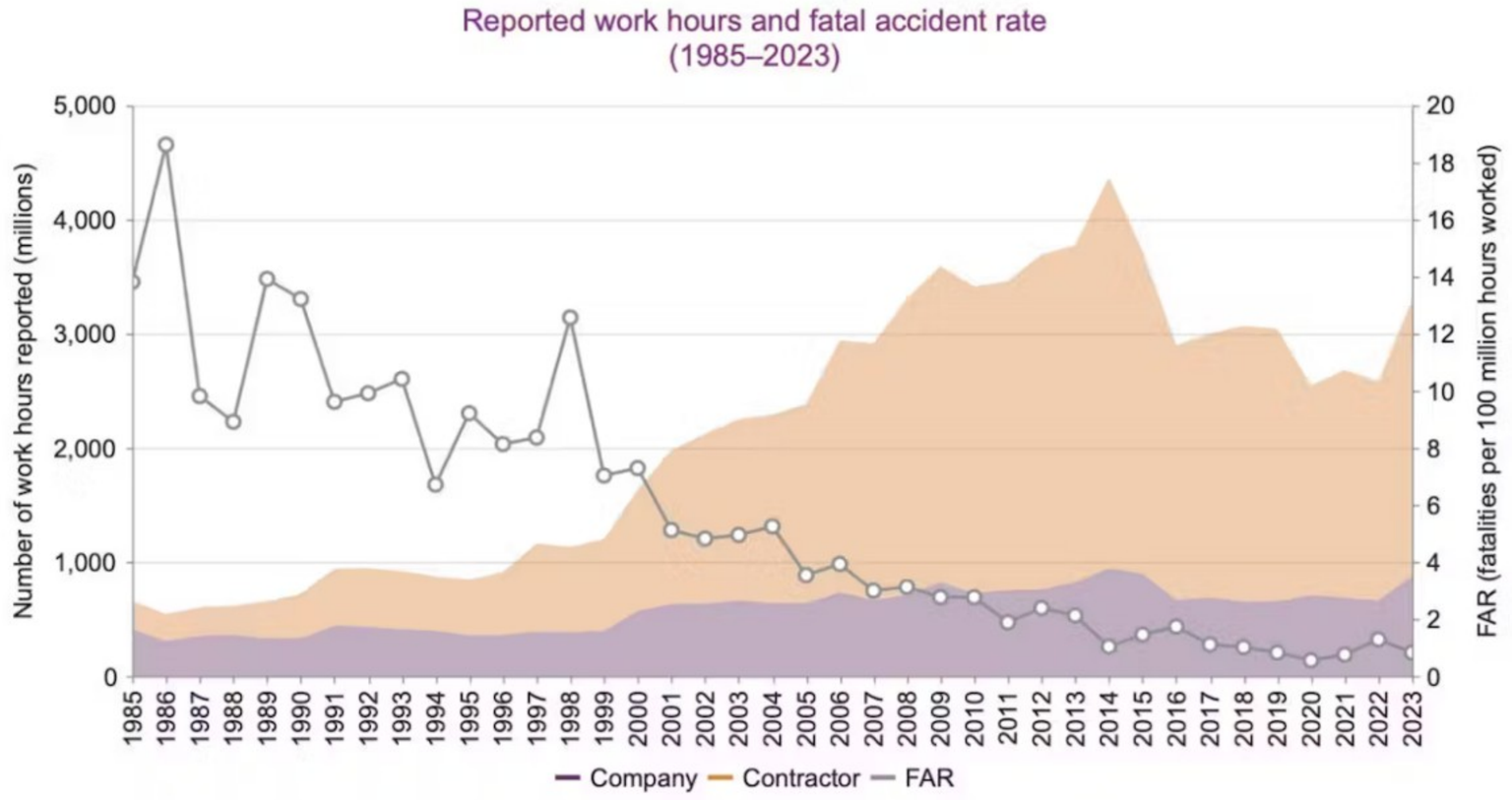


FROM SAFETY TO SAFETY SCIENCE

THE EVOLUTION OF THINKING AND PRACTICE

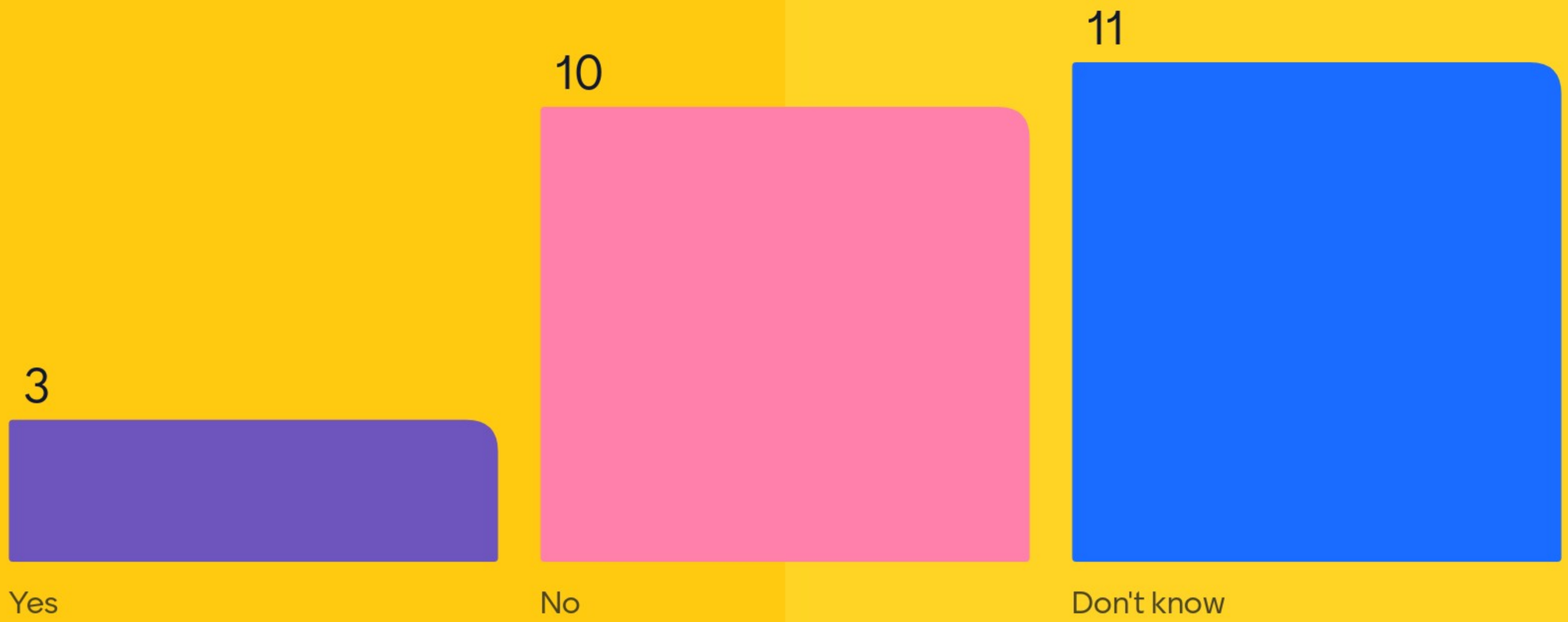
Paul Swuste, Jop Groeneweg, Coen van Gulijk,
Saul Lemkowitz, Yvette Oostendorp,
Walter Zwaard and Frank W. Guldenmund

Trends: -95%


Reported work hours and fatal accident rate
(1985–2023)
Number of work hours reported (millions)
FAR (fatalities per 100 million hours worked)
5,000
4,000
3,000
2,000
1,000
0
20
18
16
14
12
10
8
6
4
2
0
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Company
Contractor
FAR

Stupid driver?

Stupid of the driver?



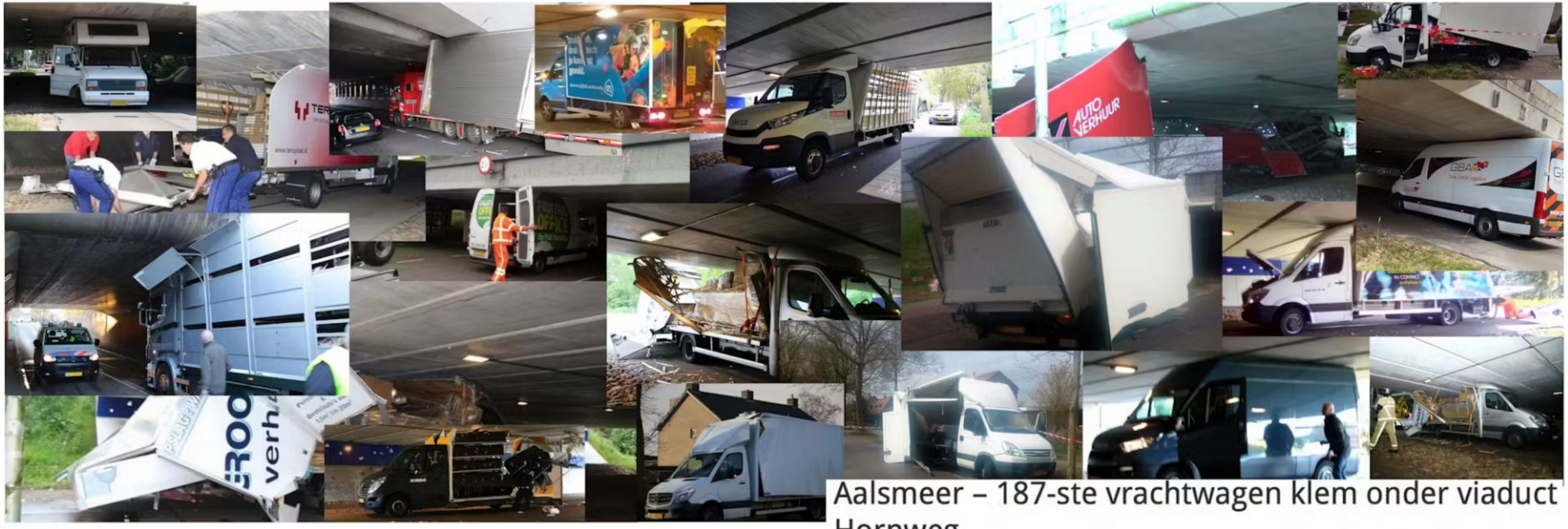
What do you want to know?

Sign with accurate height

PPE

2

Or?



Aalsmeer – 187-ste vrachtwagen klem onder viaduct Hornweg

Warnings

Lijnbus rijdt zich klem onder viaduct in Aalsmeer

Het viaduct is een bekend viaduct als het gaat om dit soort ongelukken.

TRANSPORTonline®

Foto: Inter Visual Studio | Laurens Niezen

05-06-2020 15:54 | Ongevallen | auteur Redactie

Changes

Ook zijn de wegversmallingen verwijderd omdat deze in de praktijk averechts leken te werken.

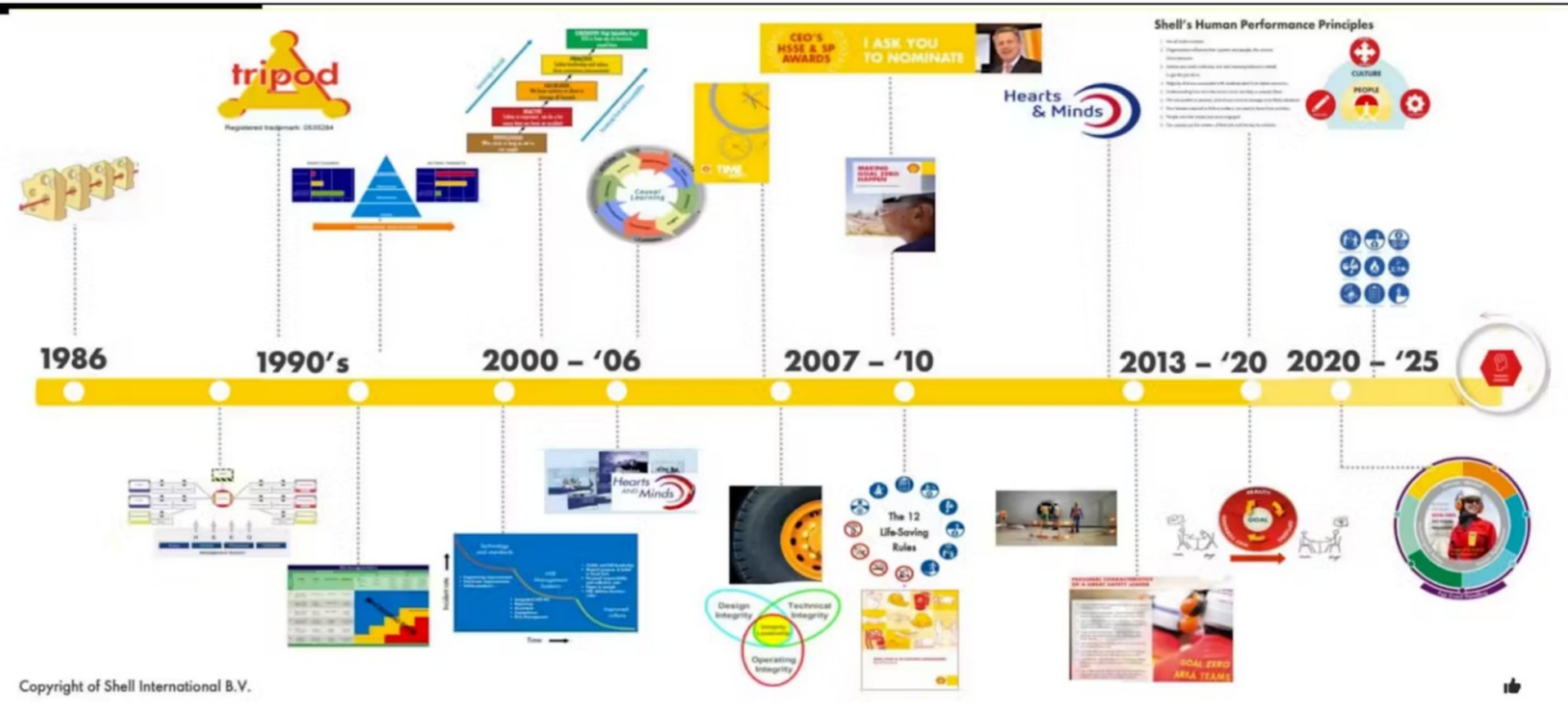
Aalsmeer – Weer een bakwagen vast onder viaduct Hornweg

Weer bestelbus klem onder viaduct Hornweg

De eerste in 2022: Klem bij viaduct Hornweg!

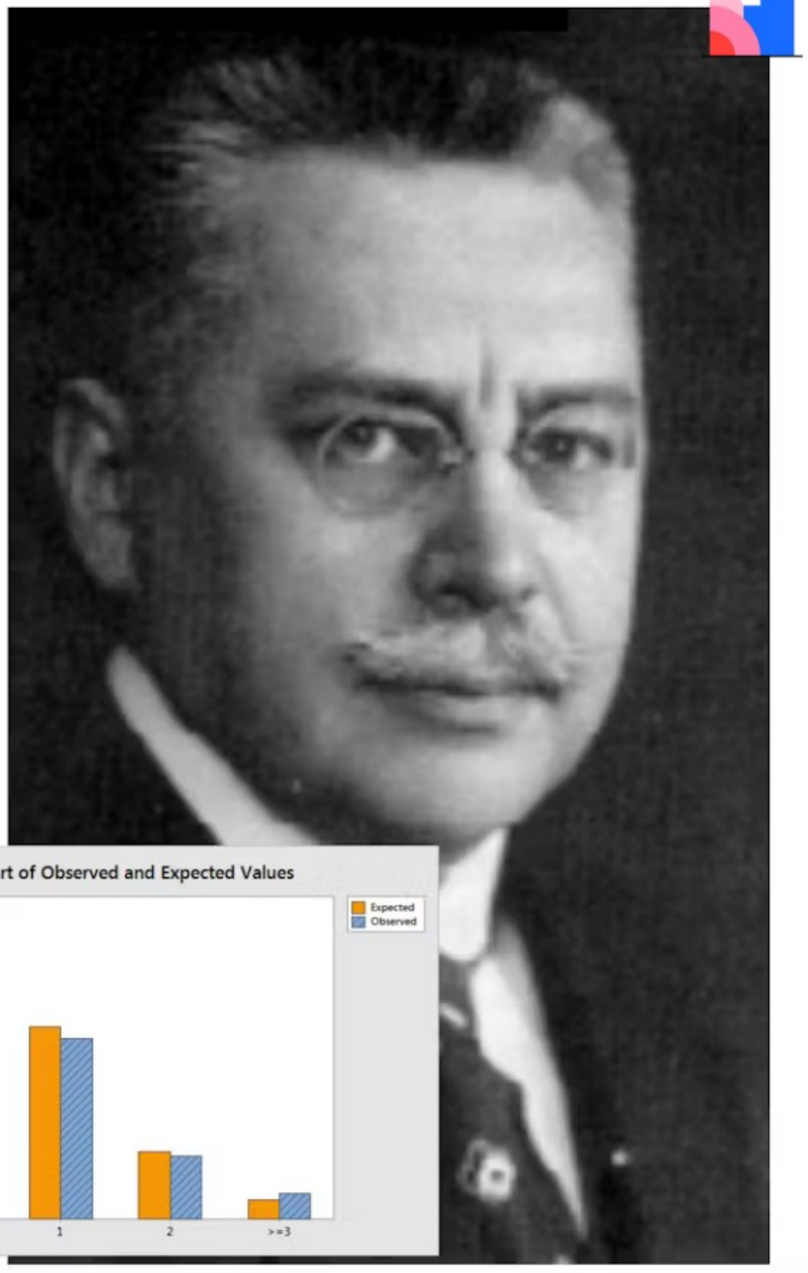

2,5m

Safety is a journey



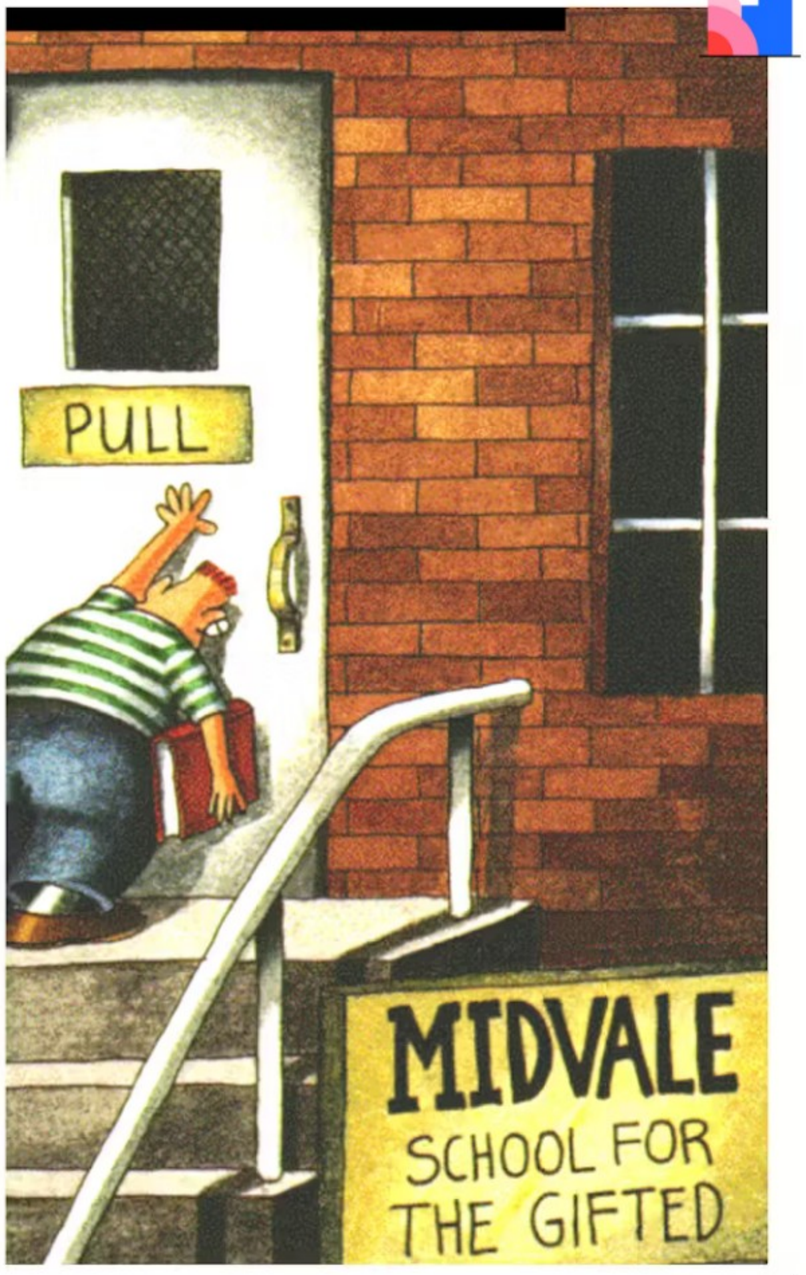
The ‘dark ages’

- Being hurt was a ‘personality trait’: Accident proneness
- Major change after research from Ladislaus Bortkiewicz, a Russian statistician who did research into people being hurt by horse kicks in the Prussian army (1898)
- It turned out the number of injured people followed a ‘Poisson distribution’, there was no need to assume a difference in proneness
- Second influence: Sigmund Freud who first explored the idea of ‘unconscious drivers’ of behaviour (1901)



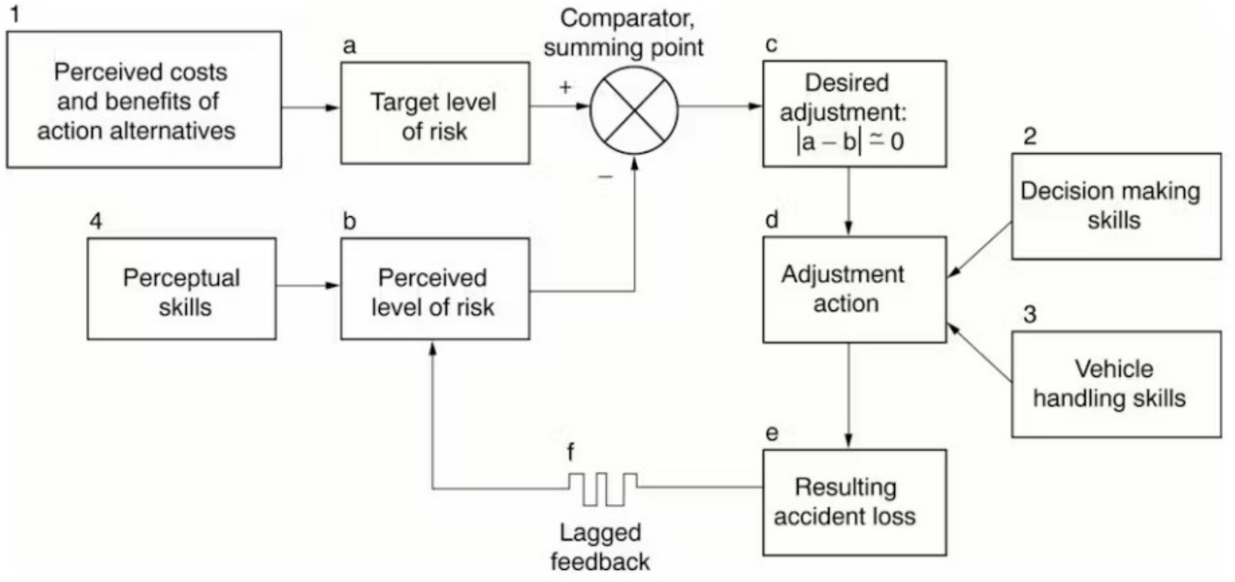
Human error

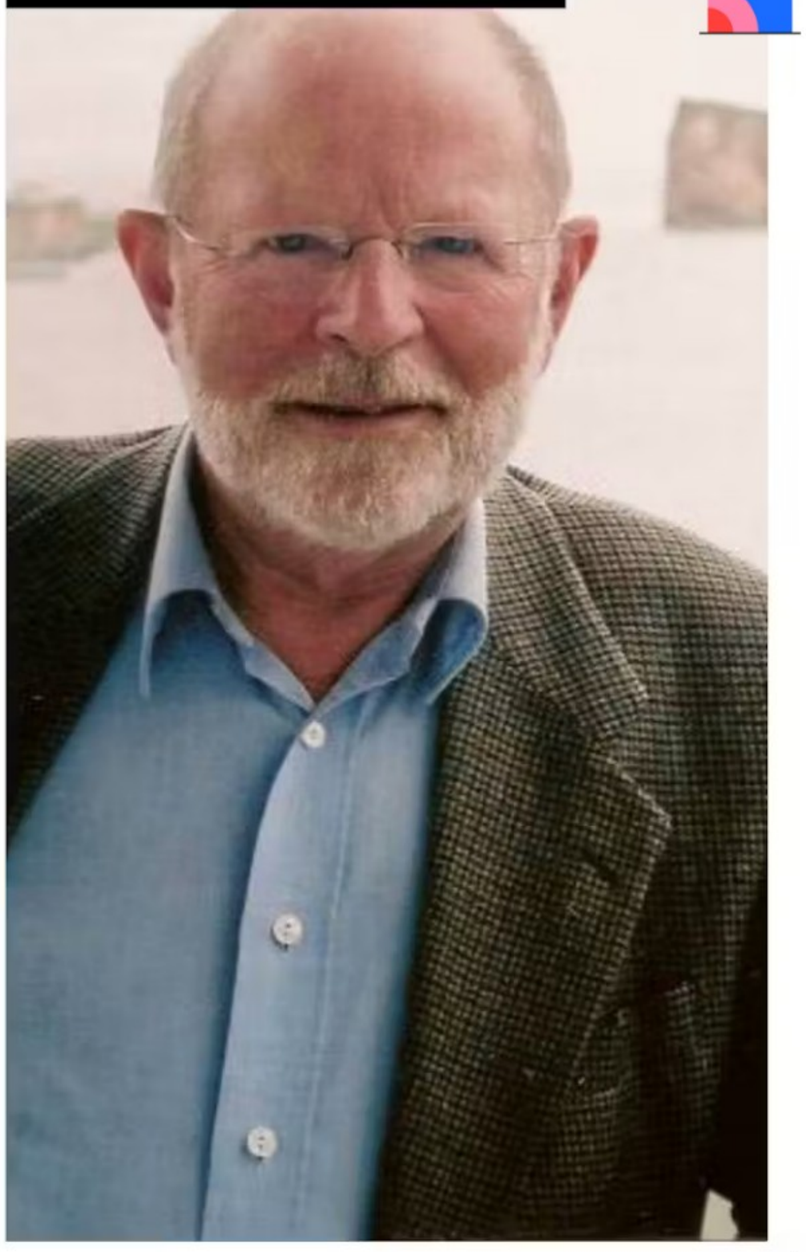
- Stupid?
- Lack of attention?
- Negligent?
- Poorly motivated?
- Lacking safety awareness?



Risk homeostasis

- Gerard de Wilde
- Law of conservation of misery





Shared space

Leiden onveiligste fietsgemeente van Nederland, raad eist actie

Leiden, 26 augustus 2024 om 14:54 uur door Louis Smit

Voor inwoners van de Havenwijk Noord is dat geen verrassing. Smalle wegen, ingewikkelde voorrangsregels en een combinatie van fietsers, motoren, auto's en voetgangers. "Hier geldt het recht van de sterkste", vertelt inwoner Aat Smits. Niet echt een verkeersveilig uitgangspunt.

Oslo got pedestrian and cyclist deaths down to zero. Here's how

More cities are starting to pedestrianise central zones to minimize cars and eliminate deaths on public roads

The before and after view of pedestrian and bicycle improvements to Oslo's City Ring Road. After five fatal crashes and 13 serious injuries between 2008 and 2017, the road's four vehicle lanes were reduced to one in each direction, accompanied by a raised, curb-separated bike lane and bus lanes. There has only been one serious injury since the redesign. Photo courtesy of City of Oslo, Norway

Risk as a number

- Ideal: people behave like rational beings
- Emotions in decision making are ‘distortions'
- Decision making is a simple cost/benefit analysis
- Prevention: only if it pays off
- Strict quantitative approach

FIA chief Jean Todt under fire for comparing Paris terrorist attack death toll to road traffic accidents

The 69-year-old is branded insensitive for using horrifying attacks which have killed at least 127 people to raise his road safety campaign

More Than 150 Gas Car Fires Per Day — Can We Please Get Serious About Electric Car Battery Fires?

Kahneman

- System 1 (Hare)
  - Fast
  - Unconscious
  - Intuitive
  - Sensitive for pictures
- System 2 (Tortoise)
  - Slow
  - Conscious reasoning
  - Evaluate
  - Sensitive for information

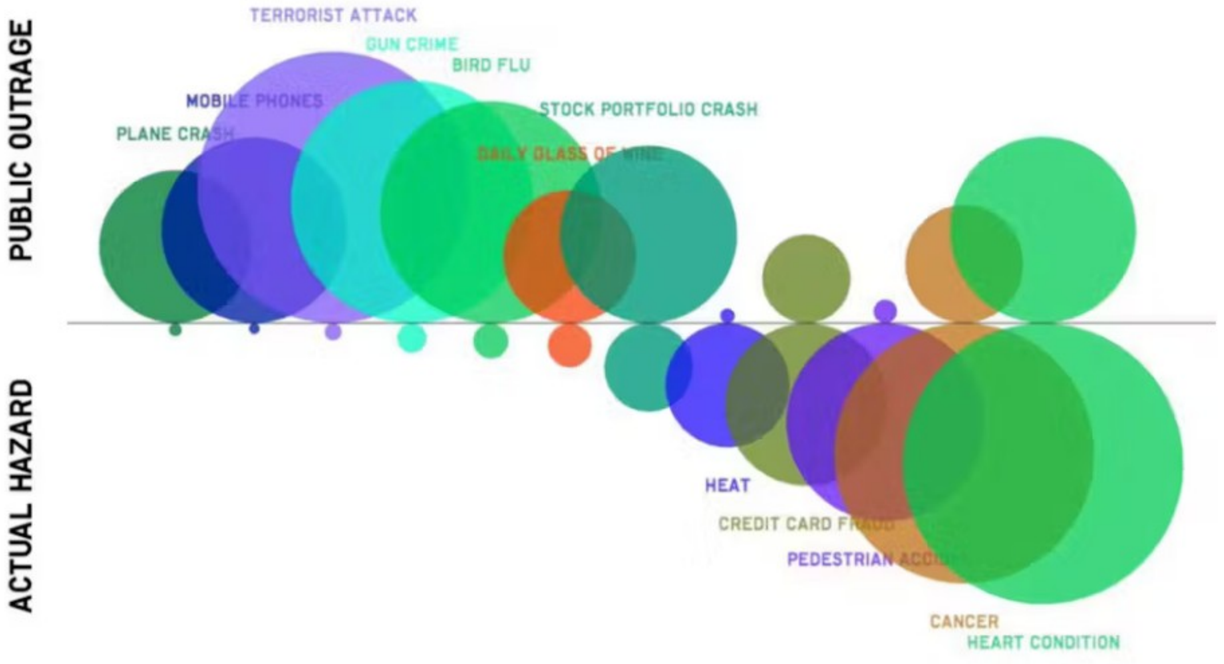
Saliency

September 11's indirect toll: road deaths linked to fearful flyers

German professor estimates an extra 1,595 Americans died in car accidents in year after September 11 attacks

Traffic in New York. Road use jumped after the September 11 attacks. Photograph: Mario Tama/Getty Images

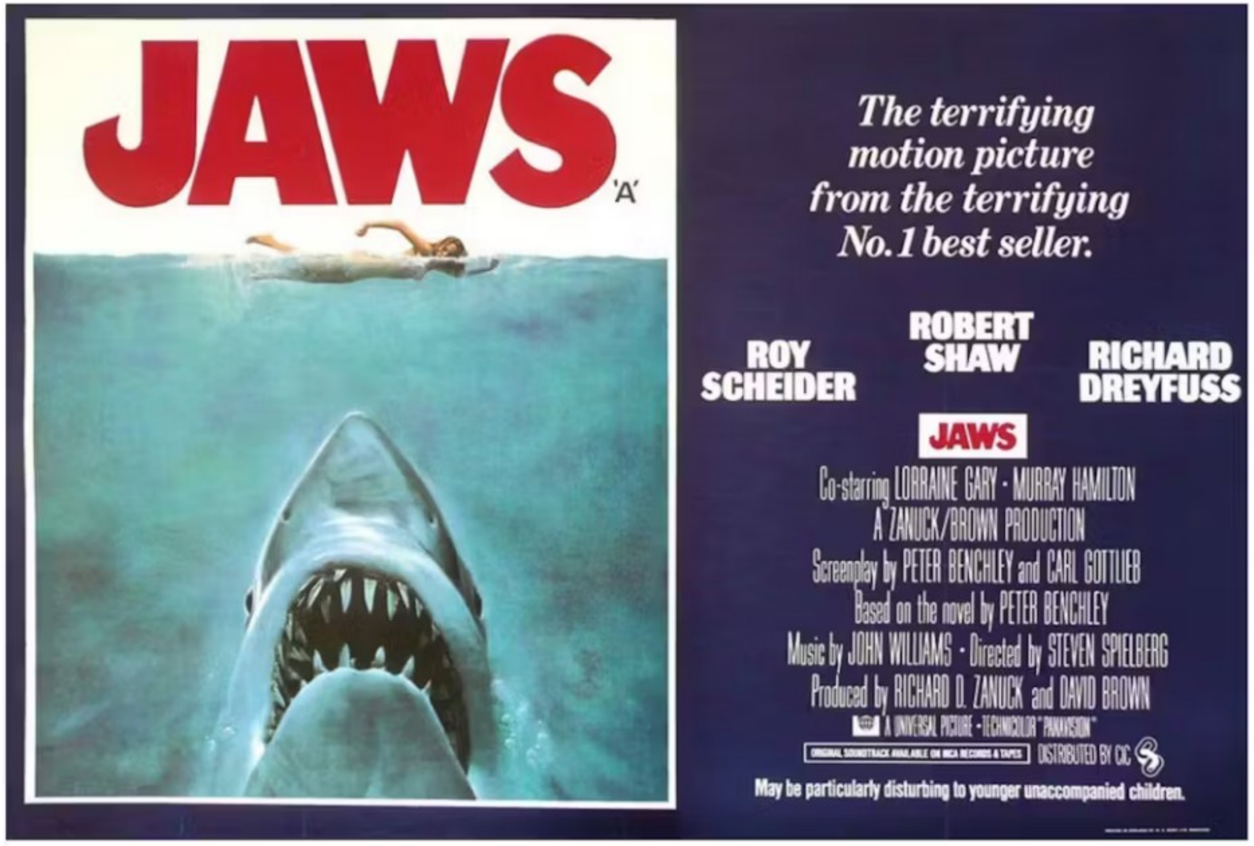
Outrage



SOME 400 HEAT DEATHS IN NETHERLANDS' HOTTEST WEEK EVER

By Janene Pieters on Friday, 21 August 2020 - 07:32

Jaws

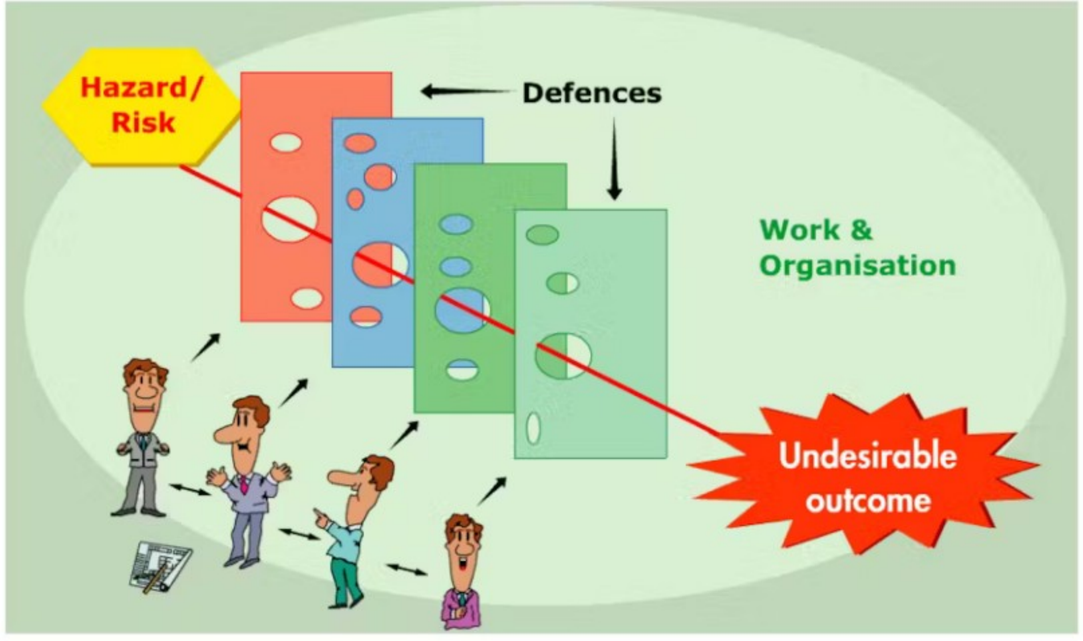

JAWS
'A'
The terrifying
motion picture
from the terrifying
No.1 best seller.
ROY SCHEIDER
ROBERT SHAW
RICHARD DREYFUSS
JAWS
Co-starring LORRAINE GARY · MURRAY HAMILTON
A ZANUCK/BROWN PRODUCTION
Screenplay by PETER BENCHLEY and CARL GOTTLIEB
Based on the novel by PETER BENCHLEY
Music by JOHN WILLIAMS · Directed by STEVEN SPIELBERG
Produced by RICHARD D. ZANUCK and DAVID BROWN
A UNIVERSAL PICTURE · TECHNICOLOR PANAVISION
ORIGINAL SOUNDTRACK AVAILABLE ON MCA RECORDS & TAPES
DISTRIBUTED BY CIC
May be particularly disturbing to younger unaccompanied children.

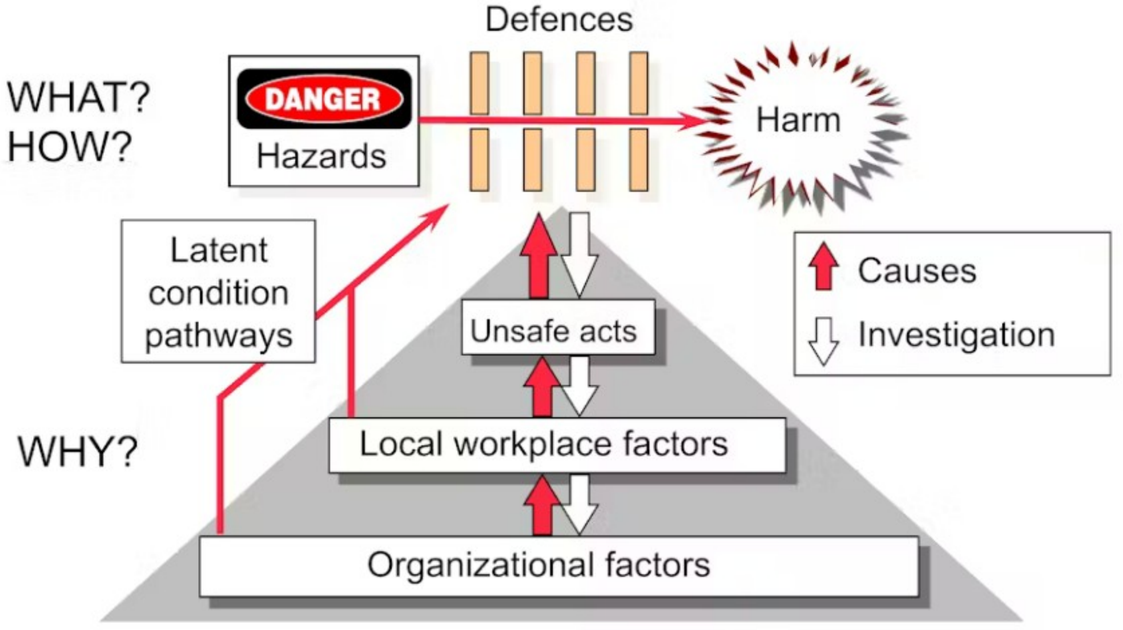
James Reason

- Worked together with Rasmussen

- Not-intentional behaviour
  - Skill-based slip (Error of commission)
  - Skill-based lapse (Error of omission)
- Intentional behaviour
  - Rule- or knowledge-based mistake
  - Violation

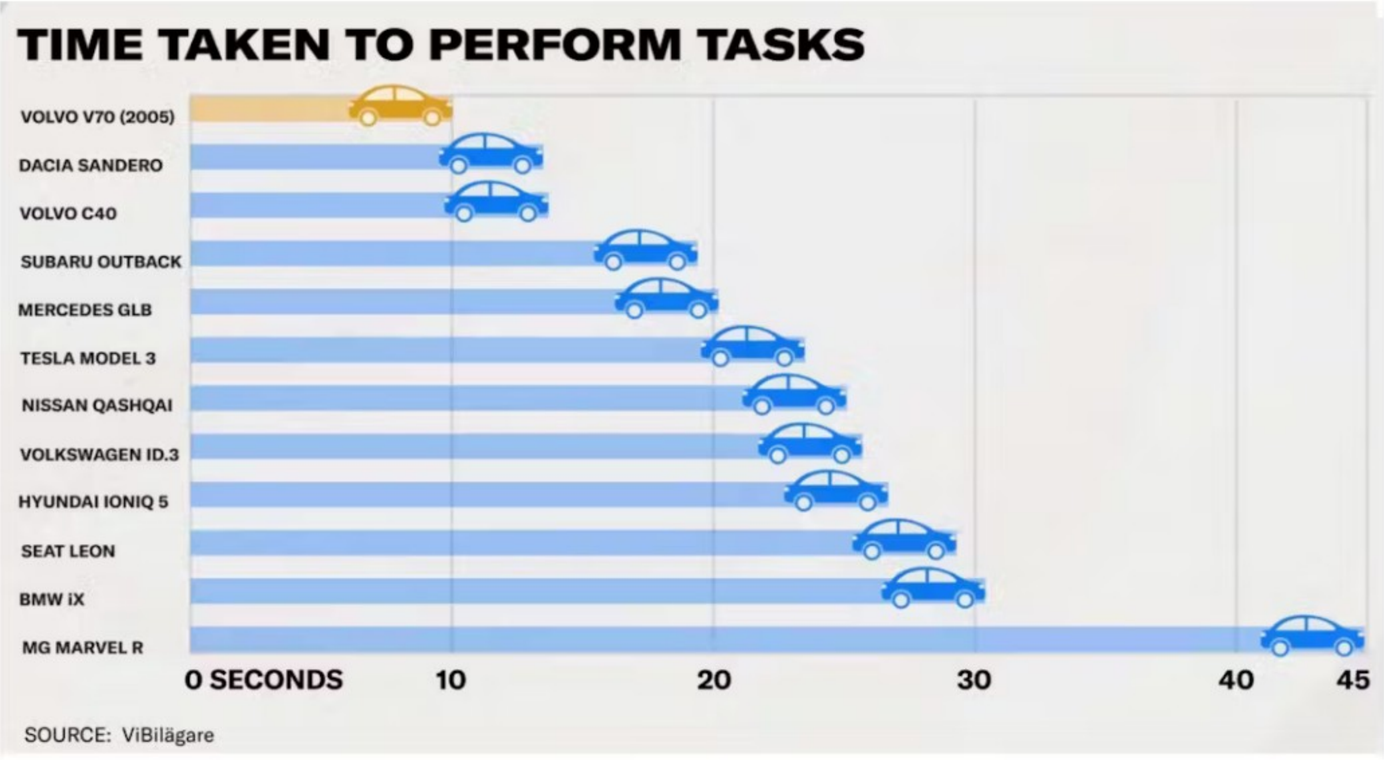
From Swiss cheese to controls





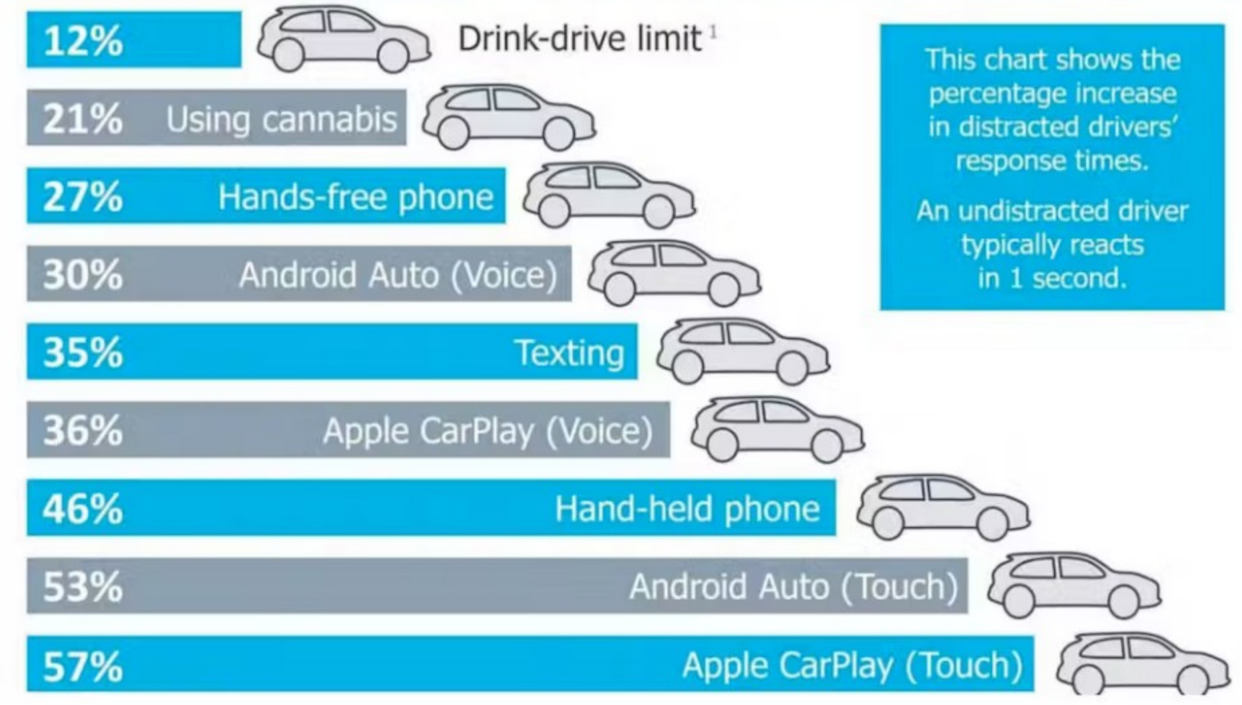

PLEASE PRESS GREY
BOX ON SCREEN
COINS
PRESS GREY BOX FIRST
BILLS
GREY BOX
CHANGE MACHINE
CREDIT CARDS
NO COINS IN HERE
$20
2
PAY AMOUNT ON SCREEN
PRESS HERE TO

The inevitable screens

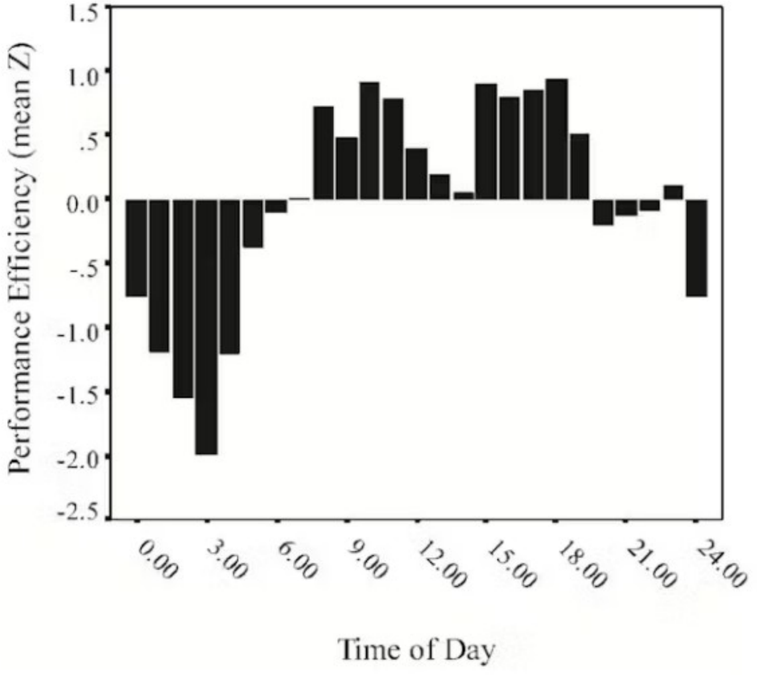


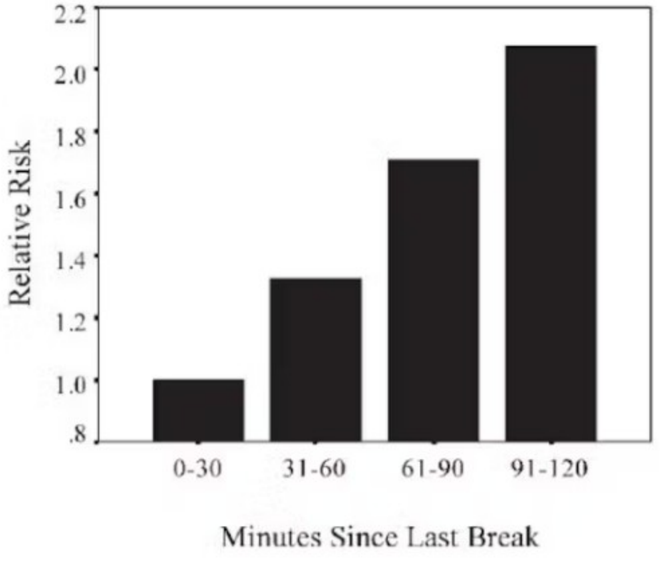
Reaction times: Apple CarPlay

HOW DRIVERS' REACTION TIMES SLOW

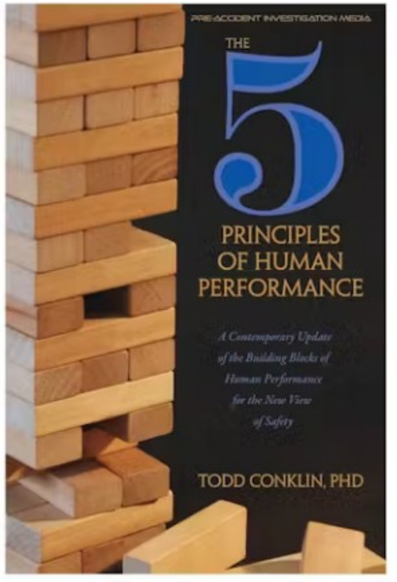


Error Enforcing Conditions: Fatigue





Human performance principles (HOP)

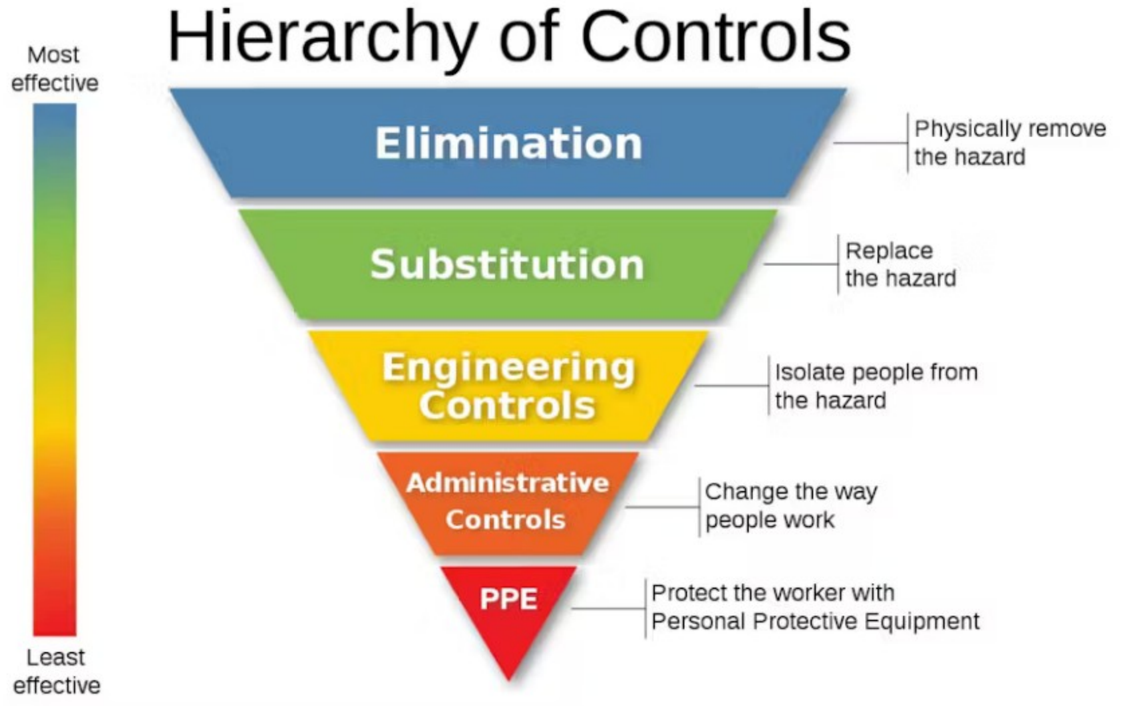


International Association of Oil & Gas Producers

energy institute

Final verdict: what works?

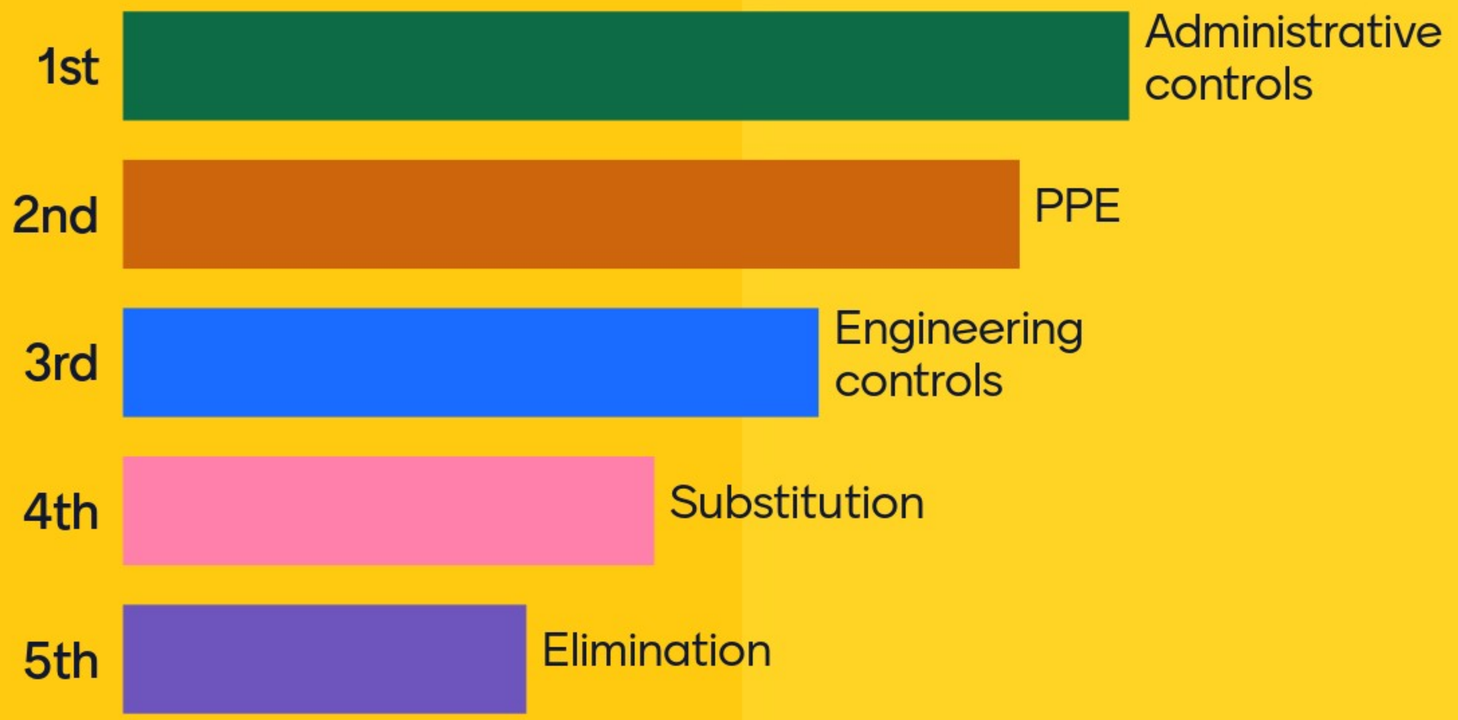
- The ‘hierarchy of controls’ model is most effective



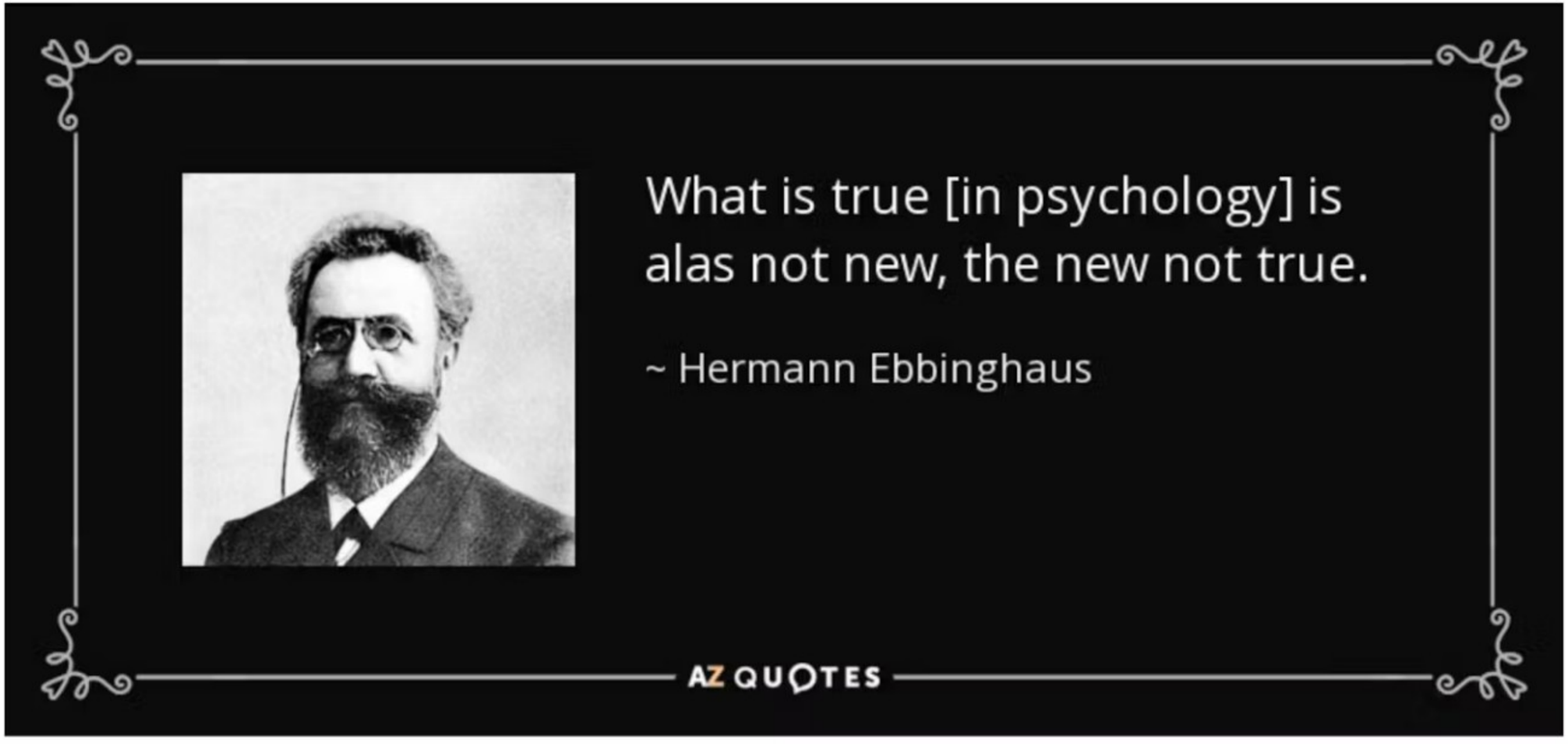
Hierarchy of controls

- Elimination:
  - Removes the hazard at the source: Eliminate the need to work on heights
- Substitution
  - Using a safer alternative to the source of the hazard: Replace a caustic cleaning agent with a non-toxic alternative
- Engineering controls
  - Engineering controls reduce or prevent hazards from coming into contact with workers: Install guardrails at worksites that are high above ground
- Administrative controls
  - Establish work practices that reduce the duration, frequency, or intensity of exposure to hazards: Install signs, labels and alarms, create written formalised operating procedures
- Personal protective equipment (PPE)
  - PPE is equipment worn to minimize exposure to hazards: Hand and arm protection e.g. (chemical-resistant gloves), hard hats, fall protection, knee pads

In general, measures of safety practitioners to control risks are aimed at



Also applies to safety science?



Some statements

- Metaphors are key to success, but are taken way too serious
- Safety practitioners and policy makers don't read scientific literature
  - IHI: 5-9% of all patient safety policies are based on scientific literature, nobody knows why these were selected, age 10-20 years
  - Books of 'famous authors' about (unproven) great ideas have impact
- Safety academics lack 'real world data' and are in general not very interested in the question whether it works or not (or in the real world at all)
- Universities and research institutes hardly contribute to developments
- Scientists in organisations and industry associations are key to success

Back to the future?!