Vietnam Airlines
SẢI CÁNH VƯƠN CAO

Safety 1st

KHÓA HỌC 2021 - 2022

NHÂN TỐ CON NGƯỜI

HUMAN FACTORS

Giảng viên: Philippe Cabon

Ngày 6-7/12/2021

ĐẠT
VHAT
CẤP CHỦ ĐỘNG
4.0

WORK TIMETABLE *(UTC +7)*

- 09H00 - 10H30 : Session
- ***10H30 - 10H45 : Break***
- 10H45 - 12H15 : Session
- ***12H15 - 13H15 : Lunch***
- 13H15 - 14h45 : Session
- ***14H45 - 15H00 : Break***
- 15H00 - 16H00 : Session
- ***16H00 - 16H15 : Quiz***

A QUICK ROUND TABLE

- Where are you coming from ?
- What is your current job ?
- What are you expecting from this course ?

Active participation is requested

PHILIPPE CABON PRESENTATION

- Master in Psychology and PhD in Neuroscience
- Associate Professor in Human Factors at University of Paris, France
- Co-founder of Welbees and Human Factors consultant
- Field of expertise:
  - Human factors and safety
  - Sleep, fatigue and Fatigue Risk Management System
  - Health and Safety

Contents

- Definition of human factors
- Scope and applications of human factors
- Human physiology
- Perception
- Cognition
- Fatigue & Stress
- Psychosocial factors
- Organisational factors and safety culture

DEFINITIONS OF HUMAN FACTORS

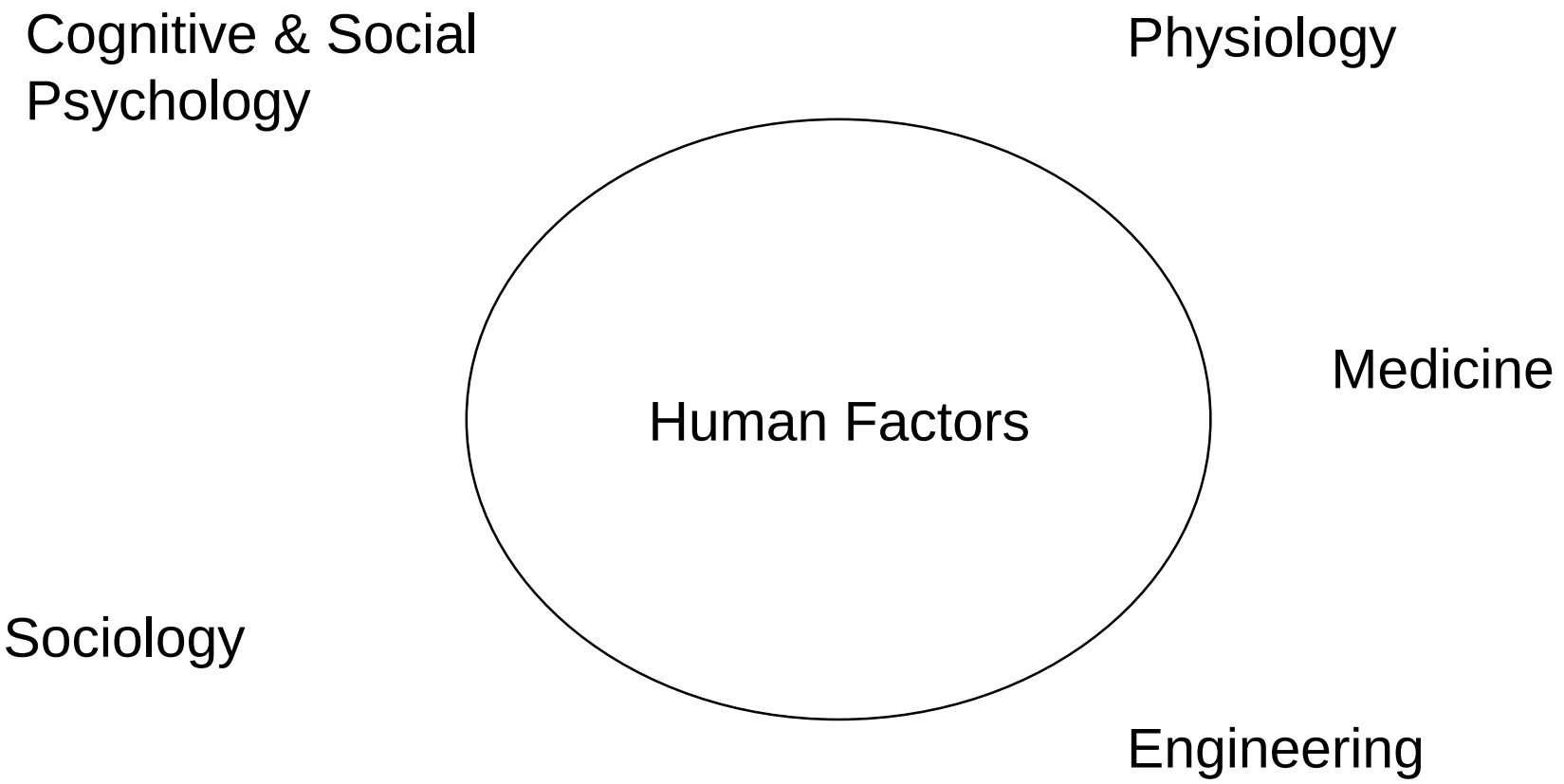
DEFINITION OF THE INTERNATIONAL ERGONOMICS ASSOCIATION

Human Factors is the scientific discipline concerned with the understanding of ***interactions among humans and other elements of a system***, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

DEFINITION OF ICAO

"Human Factors is about people: it is about people in their working and living environments, and it is about their relationship with equipment, procedures, and the environment. Just as importantly, it is about their relationships with other people ... Its two objectives can be seen as safety and efficiency."

HUMAN FACTORS IS MULTIDISCIPLINARY



WHY HUMAN FACTORS ARE IMPORTANT?

- Human can't be ignored: he is a part of the problems as well as a part of the answers
- We are prone to focus on human error. But error of who?
  - Automatism design, use of automatisms, training, certification, operator's tasks, management decision…
- **Human factors studies aims at improving performance and protecting people and equipment**

SCOPE AND APPLICATIONS OF HUMAN FACTORS

The application of Human factors in aviation (1/3)

Flight operations:

- Mandatory Crew Resource Management (CRM) or Human Factors training to reduce/detect and recover flight crew errors, improve effectiveness of decision making
- Pilot's Human Performance and Limitations
- Management of flight crew pairing
- Fatigue Risk Management

The application of Human factors in aviation (2/3)

Aircraft/equipment design:

- User centered approach to improve Human-Machine interface
- Support error detection and recovery and error consequences
- EASA CS25.13.02: ergonomics requirements for design and aircraft certification

The application of Human factors in aviation (3/3)

Maintenance Engineers:

- Mandatory Human Factors training
- Maintenance Error Decision Aid (MEDA)
- Physical environment effects (temperature, lighting, noise,…)
- Shift handover procedure

BUT WHAT KIND OF HUMAN?

"Hunter Gatherer“ Neolithic
12 000 years ago

No genetic changes occurred.

We are still equipped for that "old" life.

THE HUNTER AND THE FIGHTER

To achieve the mission, the Hunter has to be selected, trained and protected

APPLICATIONS OF HUMAN FACTORS

- Physical
  - anthropometric, and biomechanical characteristics as they relate to physical activity

- Cognitive
  - mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system

- Organisational
  - optimization of socio-technical systems

A DAY IN THE LIFE (NORMAL ACCIDENT, PERROW)

You have an important decision meeting downtown. Your spouse has already left. Unfortunately he/she left the glass coffee pot on a lit burner and it cracked. You desperately need your coffee so you rummage around for an old coffee pot. You pace back and forth waiting for the water to boil while watching the clock. After a quick cup you dash out the door. You get in your car only to realize that you left your car and apartment keys inside the house. That's okay. You keep a spare house key hidden outside for just such emergencies.

A DAY IN THE LIFE (NORMAL ACCIDENT, PERROW)

Then you remember that you gave your spare key to a friend. There's always the neighbor's car. He doesn't drive much. You ask to borrow his car. He says his generator went out a week earlier. Well, there is always the bus. But, the neighbor informs you that the bus drivers are on strike You call a cab but none can be had because of the bus strike. You give up and call in saying you can't make the meeting. Your input is not effectively argued by your representative and the wrong decision is made.

QUIZZ : WHAT WAS THE PRIMARY CAUSE OF THIS MISSION FAILURE?

1. Human error **(leaving heat under the pot or forgetting the keys)**

2. Mechanical failure **(neighbor's car generator)**

3. The environment **(bus strike and taxi overload)**

4. Design of the system (**a door that allows you to lock yourself out or lack of taxi surge capability)**

5. Procedures used **(warming coffee in a glass pot; allowing only normal time to leave the house)**

6. Schedule expectations (**meeting at set time and place)**

From the INDIVIDUAL to the organisation

Environnement
National culture, justice

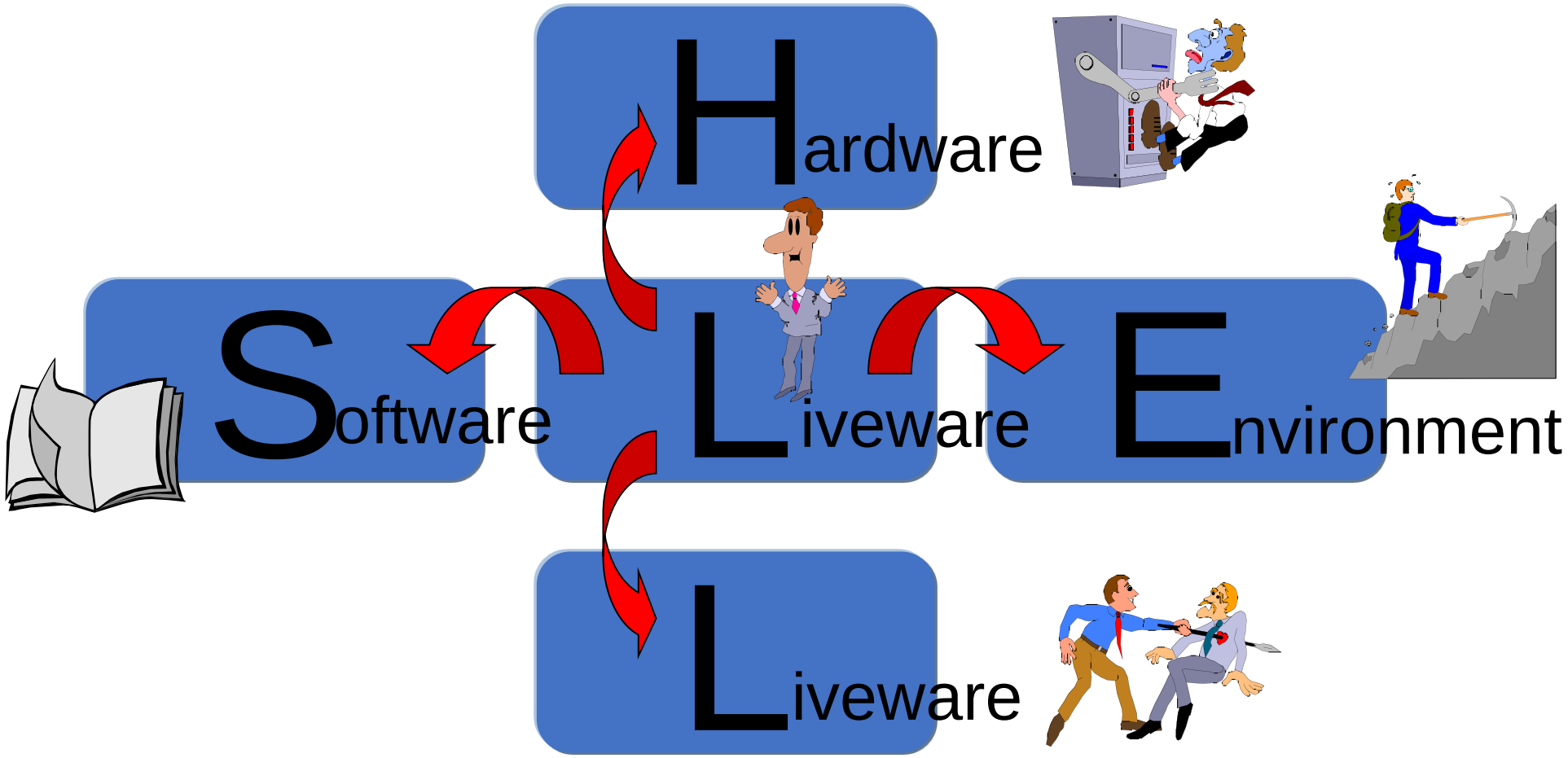
Organisation
Organizational culture, safety culture, just culture, training

Team work
Role and responsabilities, cooperation, communication

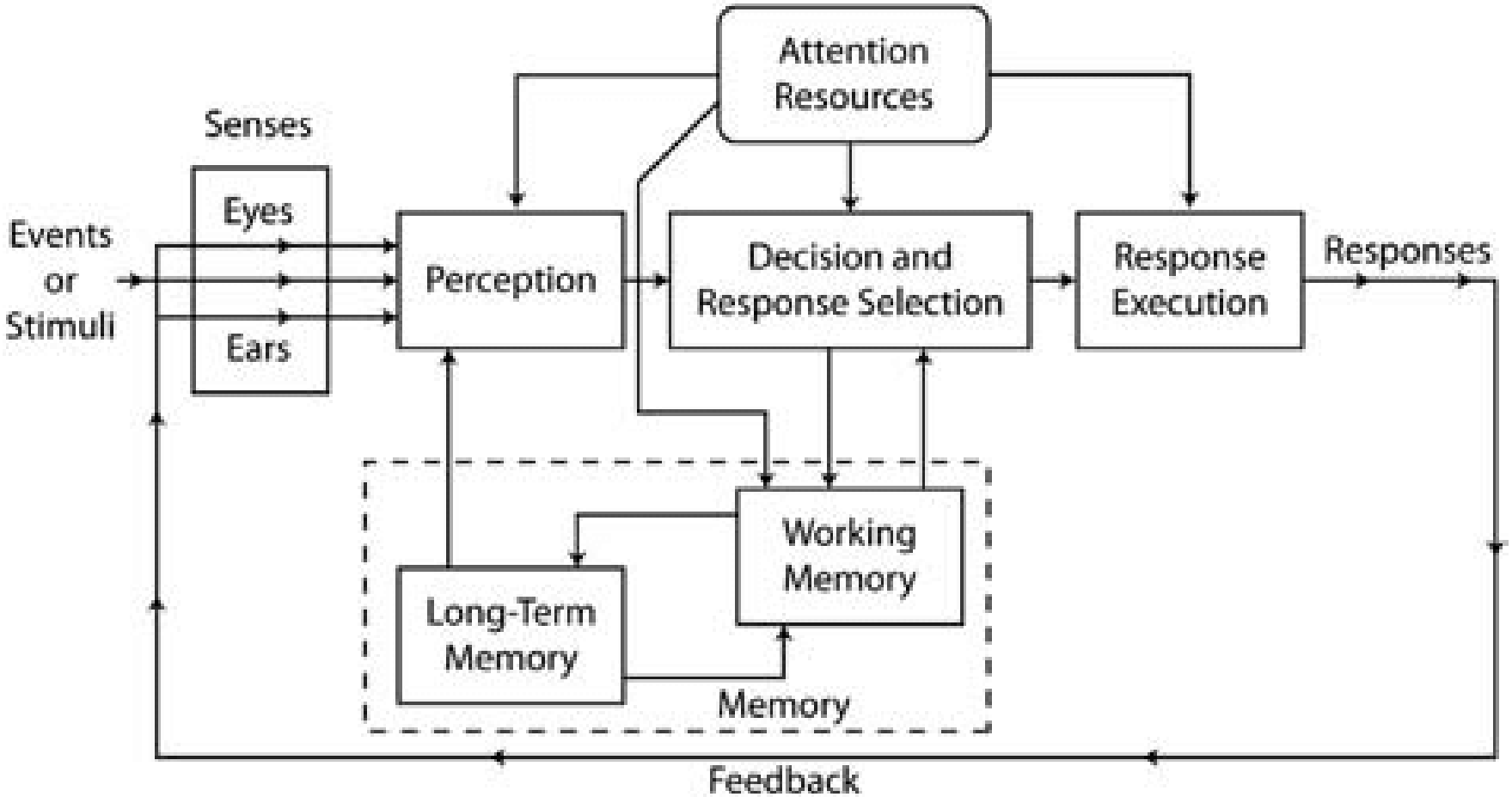
Workstation
Automation, Man-machine interface

Individual
Cognition, stress & fatigue,, motivation, human error,…

THE "SHELL" MODEL OF HUMAN FACTORS INTERACTIONS (ICAO)



Cognitive process in information processing (Wickens, 2015)



PERCEPTION

Our perception is under 3 constraints

We see what we can see

We see what we want to see

We see what we learnt to see

PERCEPTION: A ‘BOTTOM UP’ AND A ‘TOP DOWN’ PROCESS

‘Bottom up’: stimulus dependant
= what the world sends to our senses

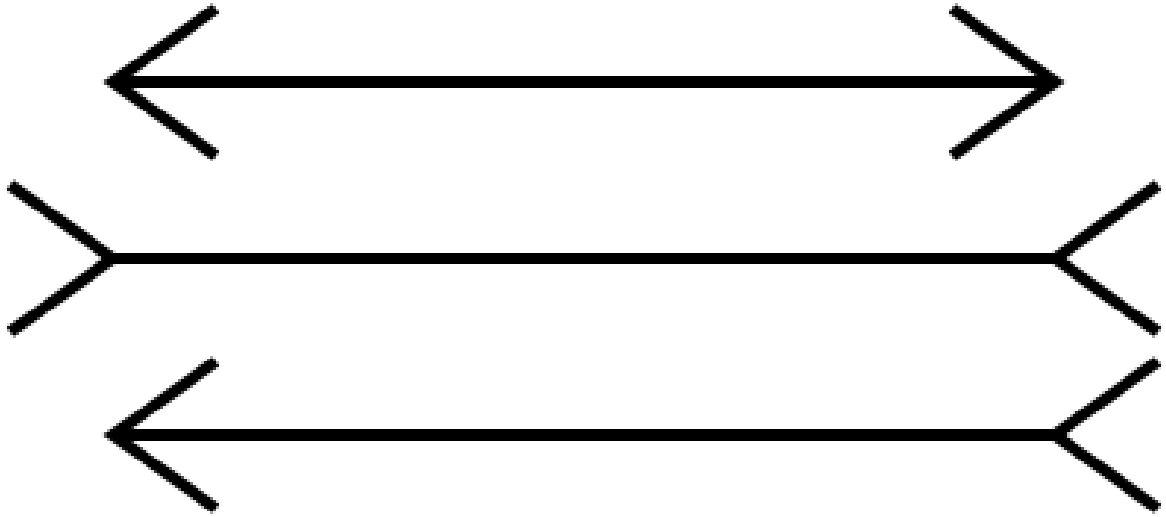
‘Top down’: concept dependant
= what we are looking for

We mainly perceive what we want to perceive!

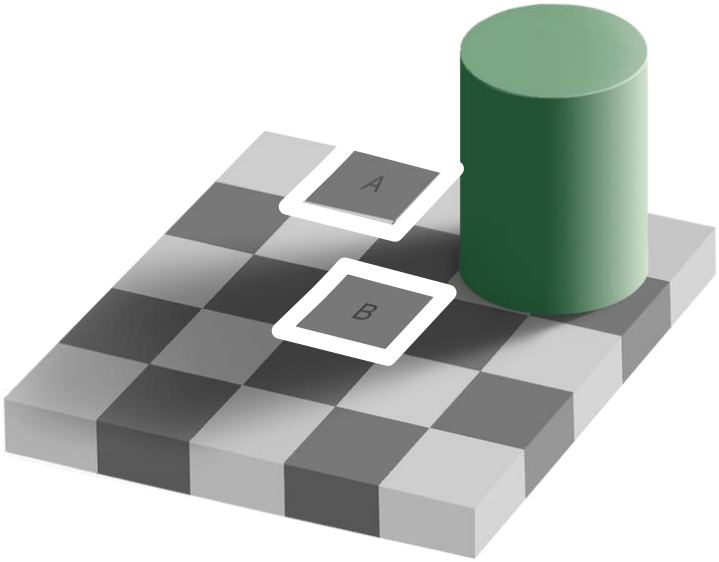
What do you see?

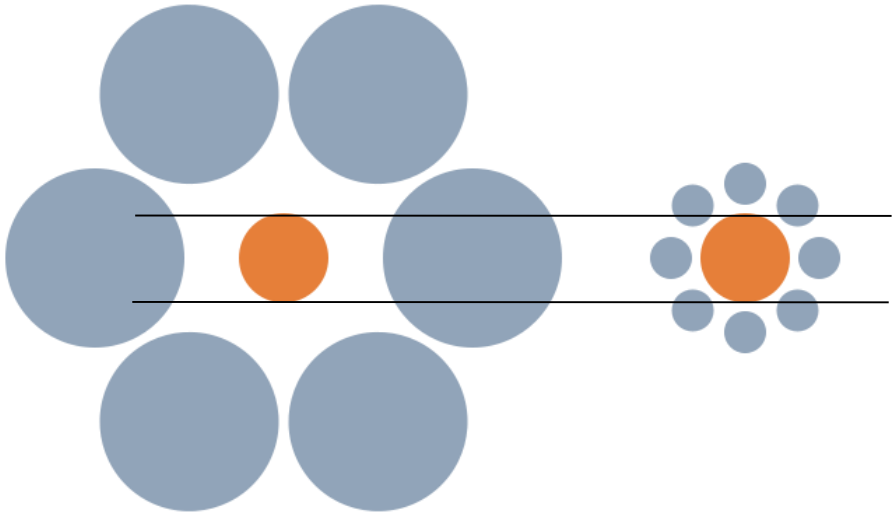
Depth perception

Which line is the longest?

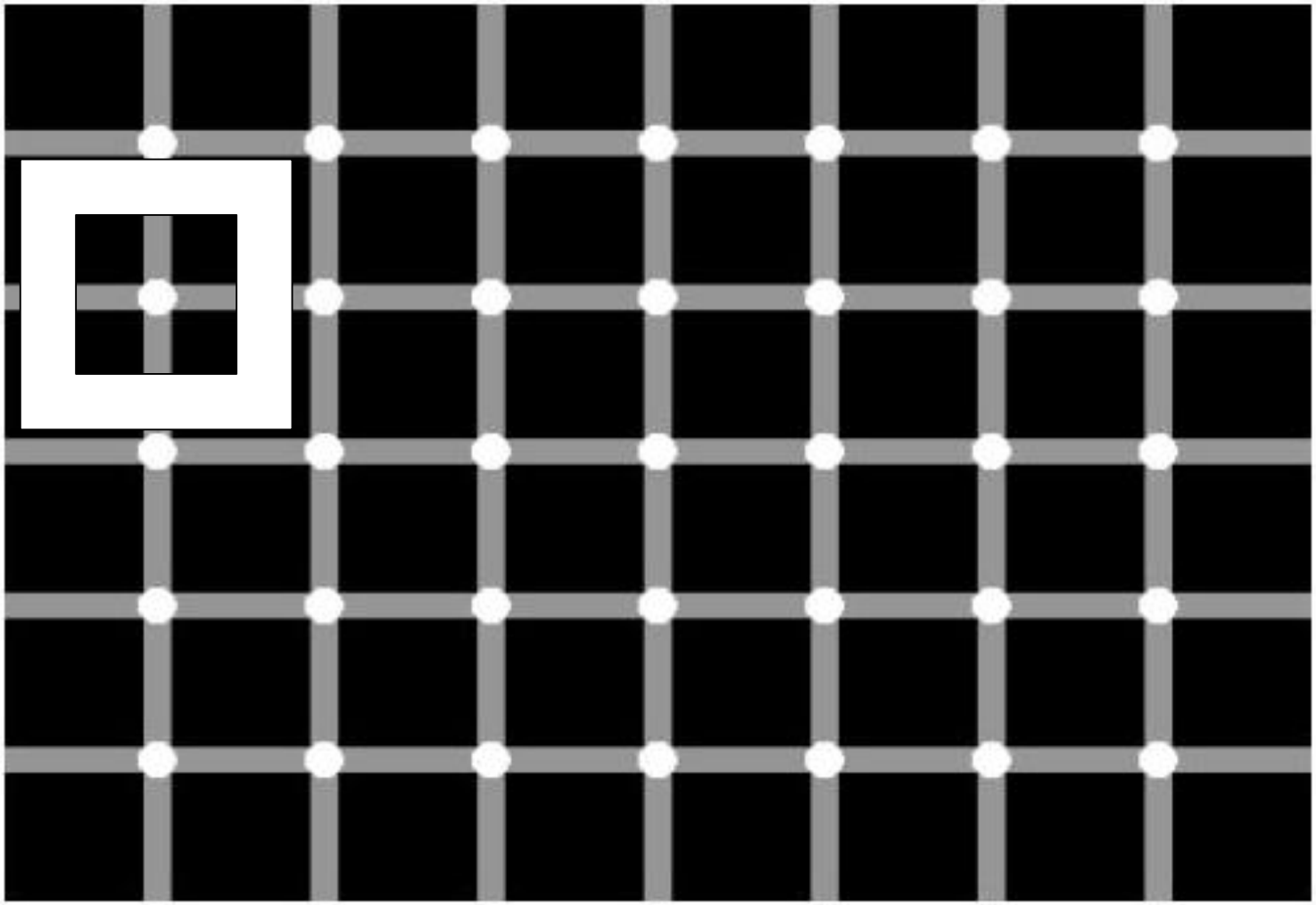


AMAZING EFFECTS



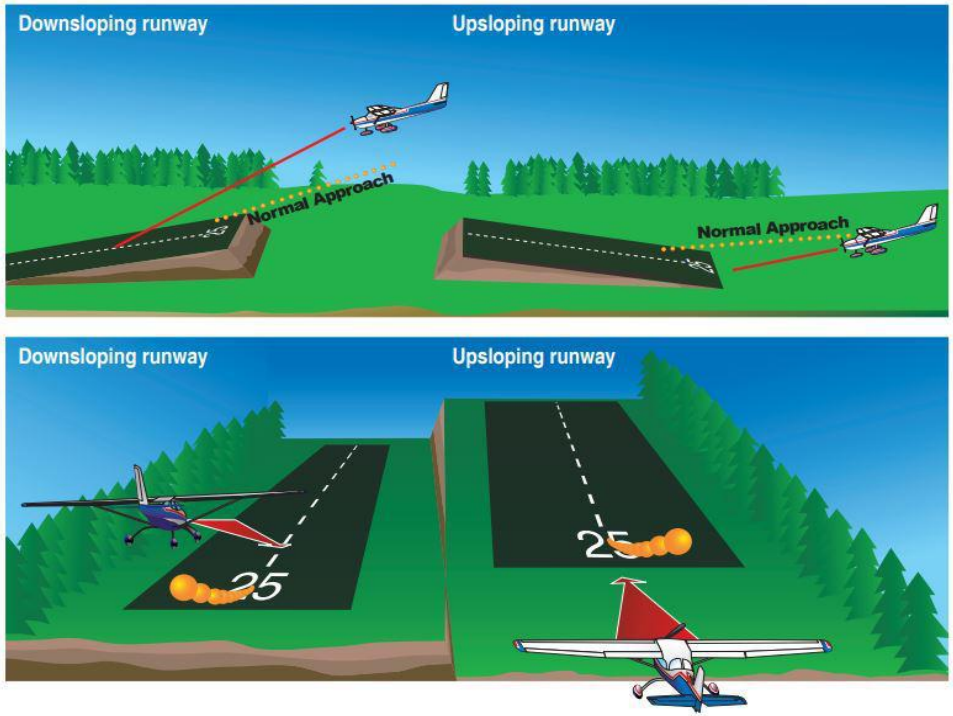


Count the black dots



Linear perspective illusions

- May make a pilot change (increase or decrease) the slope of his/her final approach because of runways with different width, upsloping/downsloping runways
- Pilots learn to recognize a normal final approach by developing and recalling a mental image of the expected relationship between the length and the width of an average runway.



Runway slope illusion

- **A downsloping runway can create the illusion that the aircraft is lower than it actually is, leading to a higher approach.**
- **An upsloping runway can create the illusion that the aircraft is higher than it actually is, leading to a lower approach.**

IMPACT ON SAFETY: Black-hole approach illusion

- During a final approach at night (with no stars or moonlight) over water, pilots may think that they are higher than they are
- Pilot may initiate an aggressive descent and wrongly adjust to an unsafe glide path below the desired three-degree glide path

Flash airlines crash, Sharm El Sheikh, 2004

Spatial disorientation

- Inability to determine one's position, location, and motion relative to the environment
- In aviation, inability to interpret aircraft attitude or speed
- Mainly due to the lack of visual reference (horizon)

Gulf Air Flight 072

- Scheduled international passenger flight from Cairo (Egypt) to Bahrain, operated by Gulf Air.
- On 23 August 2000 the Airbus A320 crashed minutes after executing a go-around upon failed attempt to land,
- All 143 on board the aircraft were killed
- Flight crew spatial disorientation during the go-around
- Causes of the accident:
  - Non adherence to a number of standard procedure and loss of spatial orientation and situational awareness by the aircraft crew during the approach and final phases of the flight.
  - A number of systemic factors were also contributed to the accident, including deficiency in crew resource management training by Gulf Air and safety oversights

The MacGurk effect

Cognition

COGNITIVE FUNCTIONS

- Understanding
- Memory
- Schema
- Learning
- Decision
- Attention

- Human error and violation

SHORT TERM MEMORY

- Capacity for holding a small amount of information in memory in an active, readily available state for a short period of time.
- Duration of short-term memory around 10 to 15 seconds.
- Estimates of short-term memory capacity limits from about 4 to 9 items.
- Very fragile and sensitive to distraction.

Strategies to increase the number of items : gather them into meaningful “chunks”

Easier to remember

203 457 678 890

than

20 34 57 67 88 90

WORKING MEMORY

- Working memory refers to structures and processes used for temporarily storing and manipulating information.
- Fed with environment perception and knowledge in LTM.

- This memory is:
  - limited in capacity thus selective
  - shaped and targeted by action projects

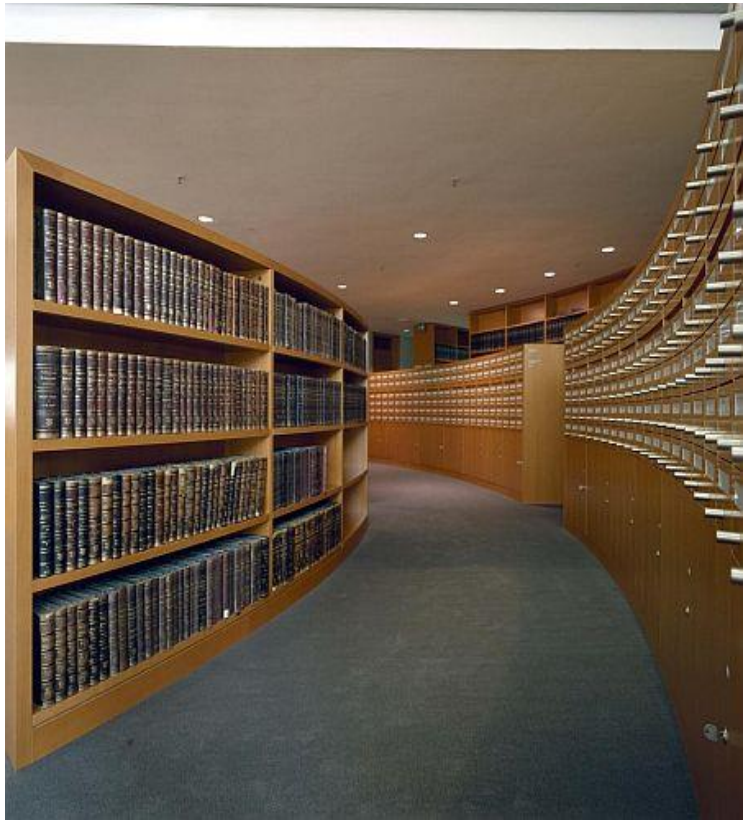
In case of memory overload: unconscious ”removal”

Application of working memory

- reading (phonological loop)
- problem solving (central executive)
- navigation (visual and spatial processing)

LONG TERM MEMORY

- Contains all knowledge
- Unlimited capacity, acquisition until death
- Nothing is forgotten… but all could be mislead
- Impossible to know if something is in memory
- Memories are very much associated to the circumstances of the events



What were you doing on 9/11 2001?

LONG TERM MEMORY AND KNOWLEDGE

- Two forms of knowledge in memory:

Declarative **knowledge**

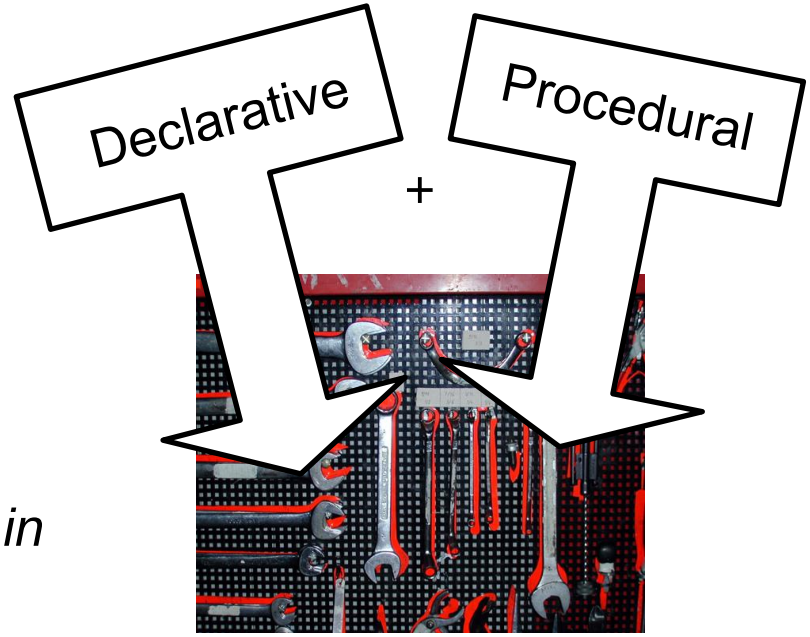
When we know "that":
continents, HDMI plug exists…

We need to know both "that" and "how" to develop adaptive strategies in context.

Procedural knowledge

When we know "how" to drive, how to reach my home from… by bus

Memory



Individual Repertories of schemata to achieve a goal in a given context

SOME MEMORIES BIASES

- **Egocentric bias** - recalling the past in a self-serving manner, e.g. remembering one's exam grades as being better than they were, or remembering a caught fish as being bigger than it was.
- **False memory** - confusion of imagination with memory, or the confusion of true memories with false memories.
- **Hindsight bias** - filtering memory of past events through present knowledge, so that those events look more predictable than they actually were; also known as the 'I-knew-it-all-along effect'.

LEARNING: SPACING EFFECT

Distributed learning is opposed to **Massed learning**

Review of material increases long-term memory best when there is more time between introduction and review of material.

⇒ better for exams to be taken after a break than before, assuming there was a review before the exams, because of the spacing effect.

"Cramming" (intense, last-minute studying) the night before an exam is not likely to be as effective as studying at intervals over a much longer span of time.

HUMAN: AUTOMATIC (SYSTEM 1) AND ANALYTIC MODES (SYSTEM 2)

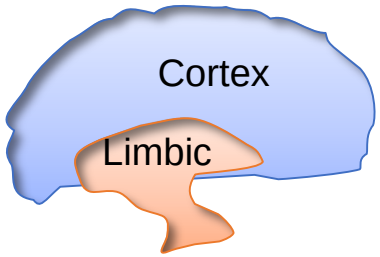
Internal model of world

Quick, immediate, few controls, robust
Short term, rigid

Experience & previous cases

Automatic mode
Sequences of routines

Very frequent, easy
High tendency to be kept with complications
Perseveration



Flip-flop by voluntary inhibition of automatic mode

Analytic mode
Controls, rereading of facts

Slow, costly in attention
Creative, adaptative

Very sensitive to stress

Assessment of situation features

Broader domain Knowledge

From C. Valot


FUGLY.COM

Two Major Types of Decision

Analytical (or rational)

- Logical, considered, careful, thorough
- No time pressures

Versus

Intuitive (or naturalistic)

- Instinctive, spontaneous
- Urgent, dynamic situation

Analytical Decision Making

Define the problem

Identify the options

Explore each option

- advantages and disadvantages

Assess the risk for each option

Select the best option and implement it

Review whether it worked

An Analytical Model: 'SADIE'

S hare the information

A nalyse the problem

D evelop solutions

I mplement the best solution

E valuate (continually)

(Adapted from Australian Airlines' ATM Program)

Analytical Decision Making works best when…

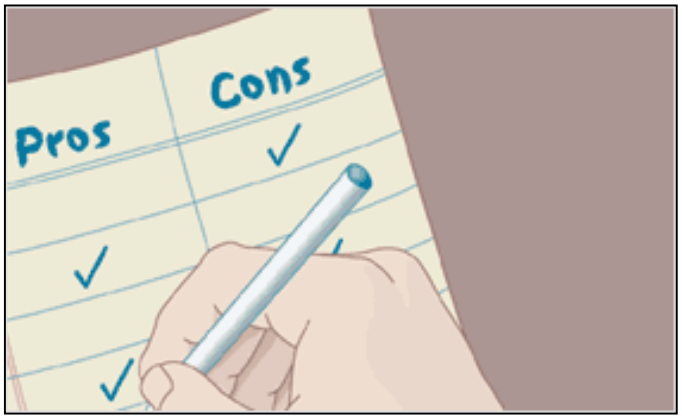
Time is not ‘critical’

The options are clearly defined

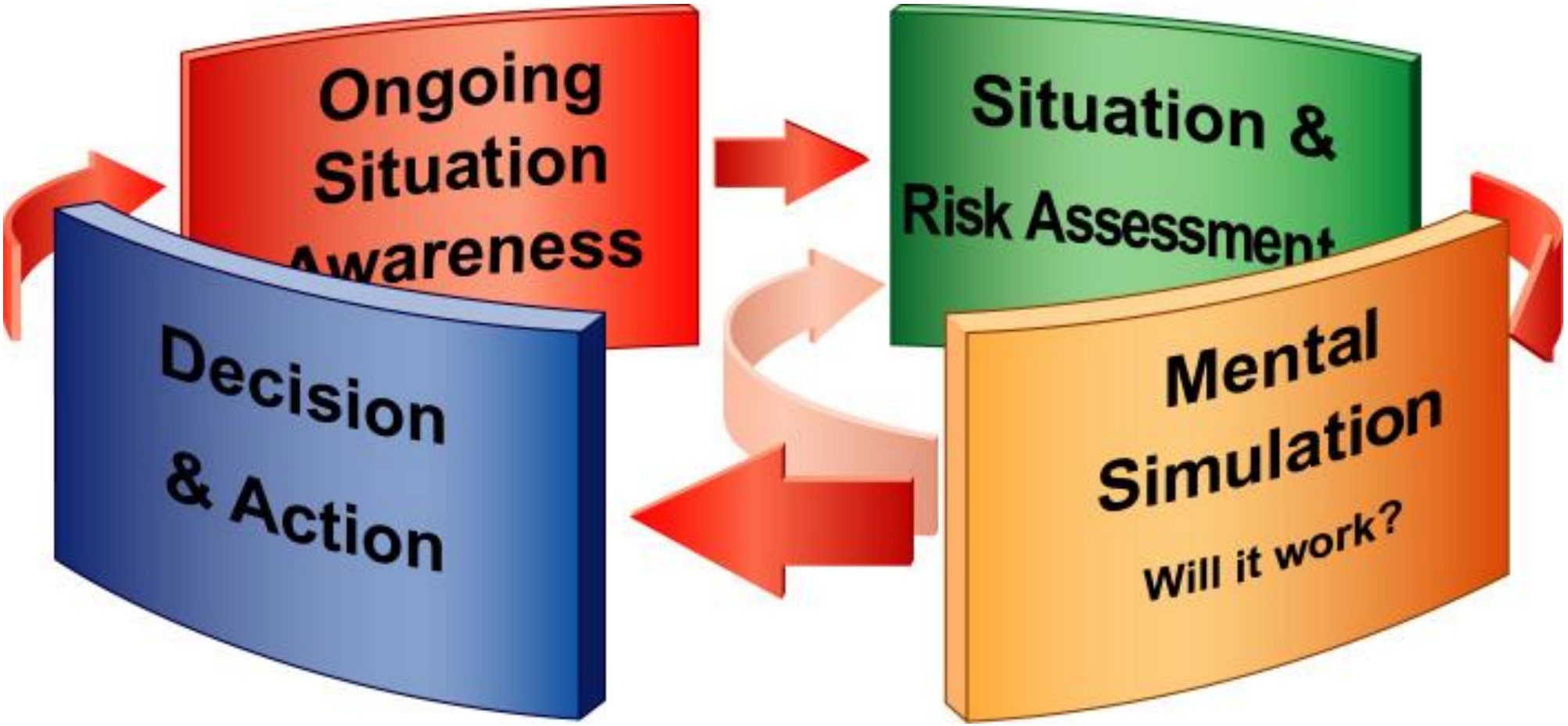
Knowledge or experience is low

We want the ‘best possible’ outcome

The decision needs to be justified or agreed to by others



Intuitive/Naturalistic Model



Intuitive Decision Making

Based on experience and knowledge

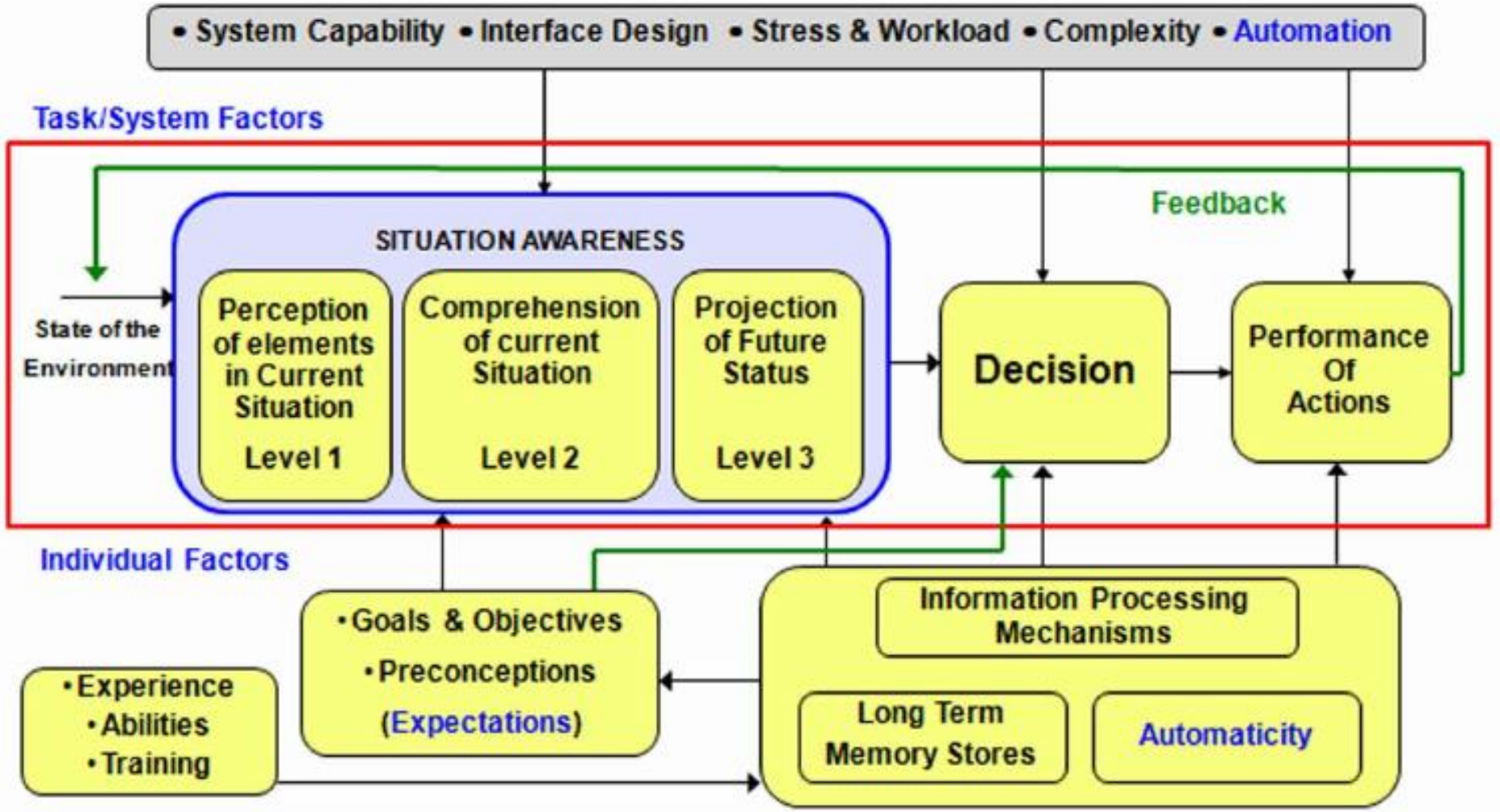
Helps us through everyday life

Good for common
or simple problems,
and those requiring
rapid response

Subject to
bias / expectancy

Examples?

Situation awareness



ATTENTION

- Definition: selecting some information for further processing and inhibiting other information from receiving further processing

The cocktail party: ability to tune our attention to just one voice from a multitude

SOME ASPECTS OF ATTENTION

- **Focused attention:** ability to respond discretely to specific visual, auditory or tactile stimuli
- **Sustained attention:** ability to maintain a consistent behavioural response during continuous and repetitive activity
- **Selective attention:** capacity to maintain a behavioural or cognitive set in the face of distracting or competing stimuli. Therefore it incorporates the notion of "freedom from distractibility"
- **Divided attention:** refers to the ability to respond simultaneously to multiple tasks or multiple task demands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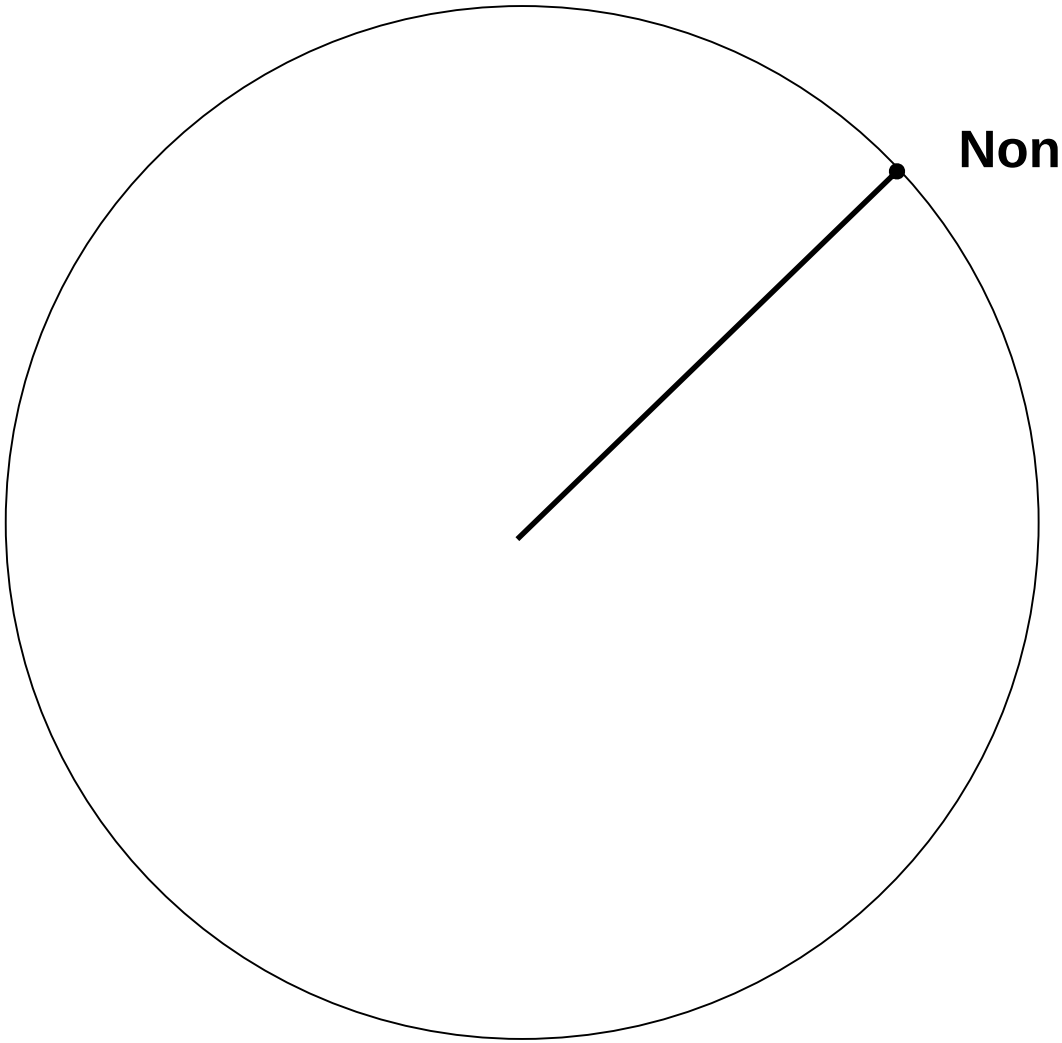
THE ATTENTION TEST

VIGILANCE

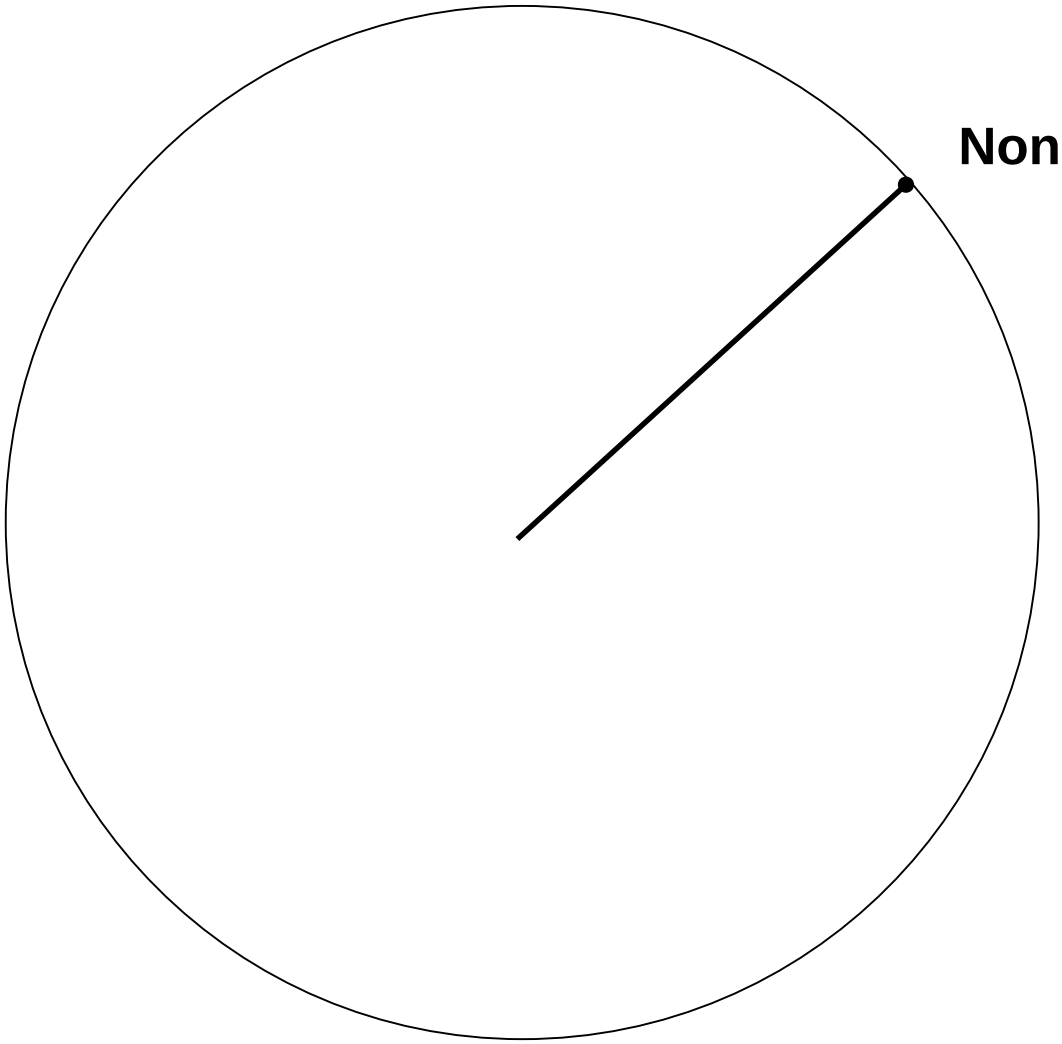
- Ability to detect rare and random signals
- Used in monitoring tasks in highly automated systems

THE CLOCK TEST (MACKWORTH, 1950)



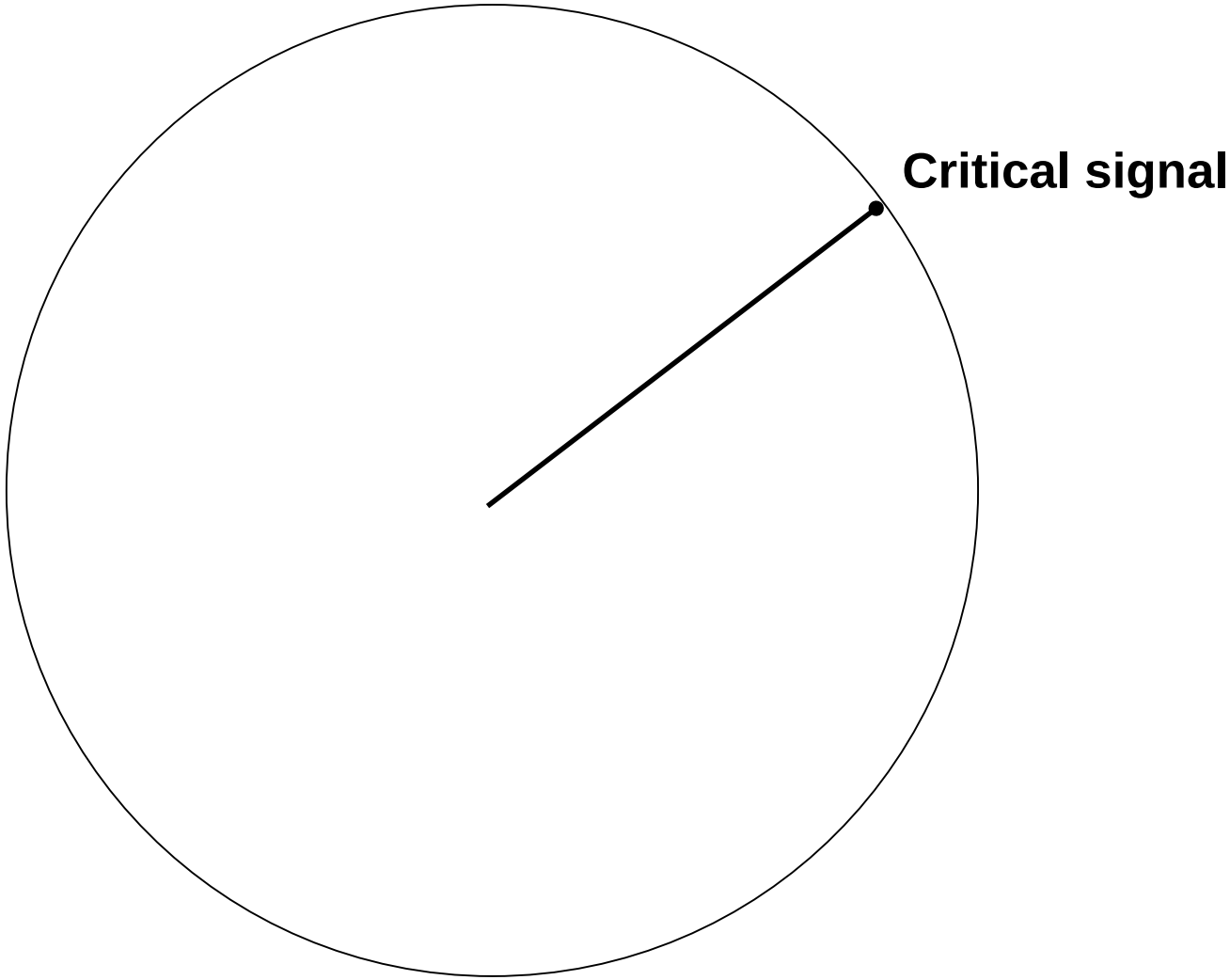
Non critical signal

THE CLOCK TEST (MACKWORTH, 1950)

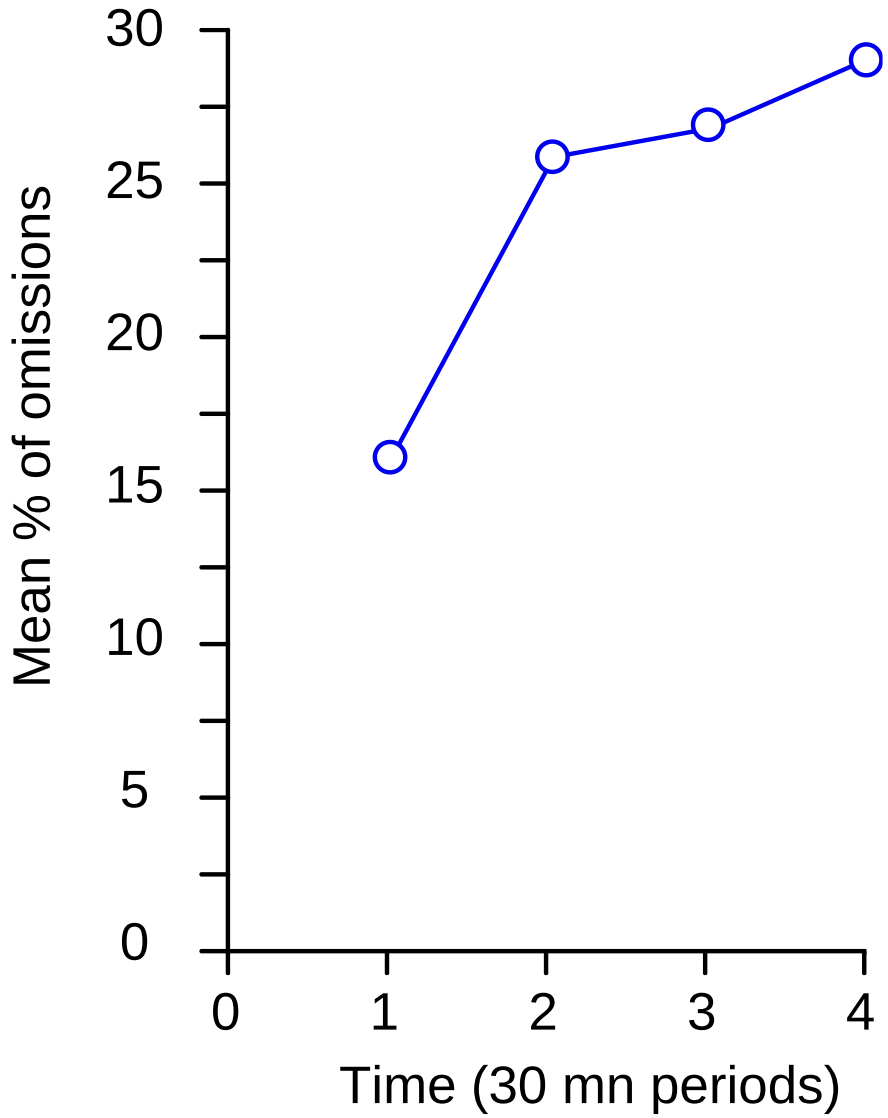


Non critical signal

THE CLOCK TEST (MACKWORTH, 1950)



VIGILANCE DECREMENT IN THE CLOCK TEST (MACKWORTH, 1950)



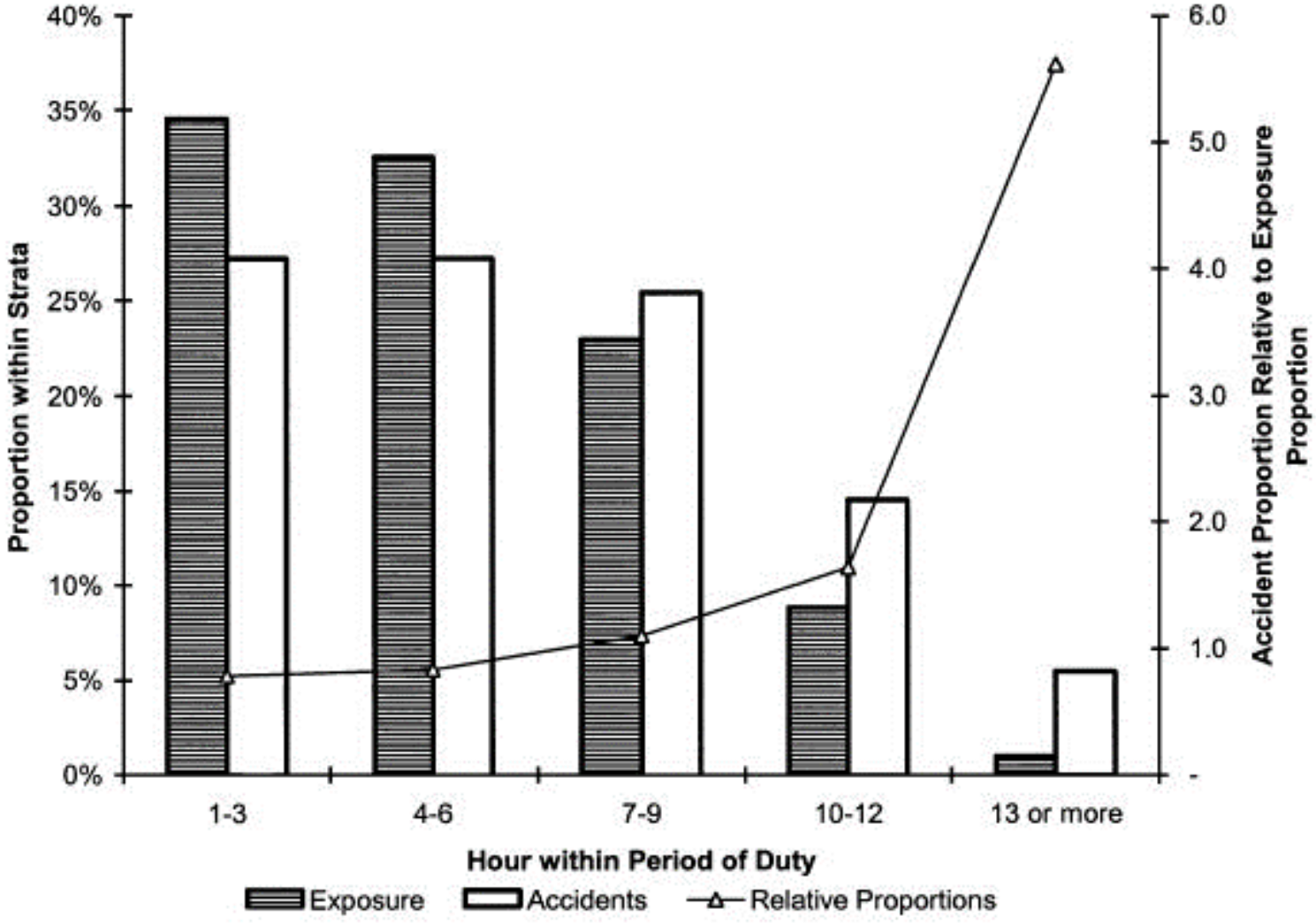
(Mackworth, 1950)

FATIGUE AND SLEEP

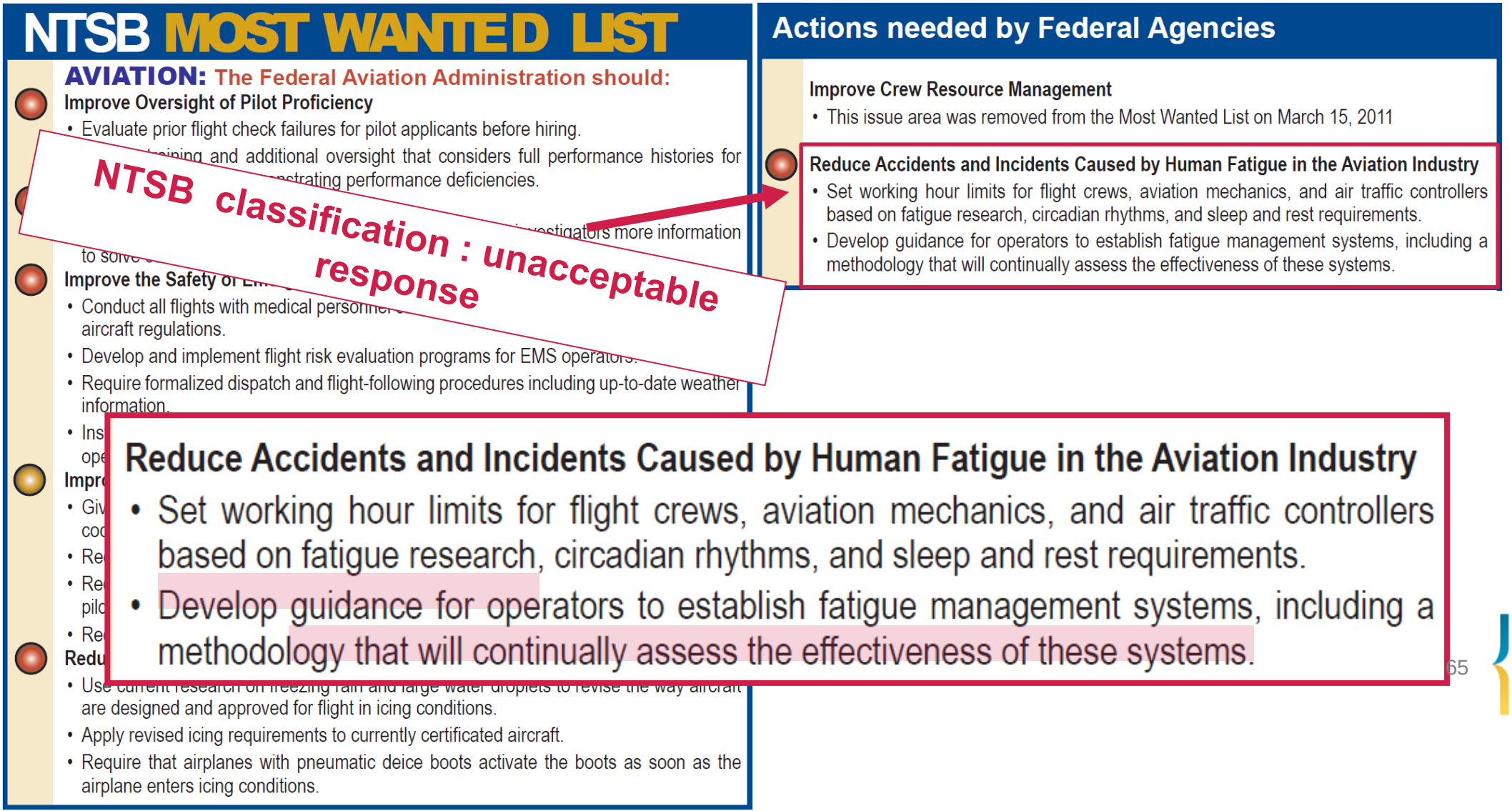
“Most of the major errors I made in my life, both political and personal, were made when I was too tired.”

Bill Clinton

ACCIDENT RISK AND DUTY TIME



More than 80 fatigue related recommendations since 1989



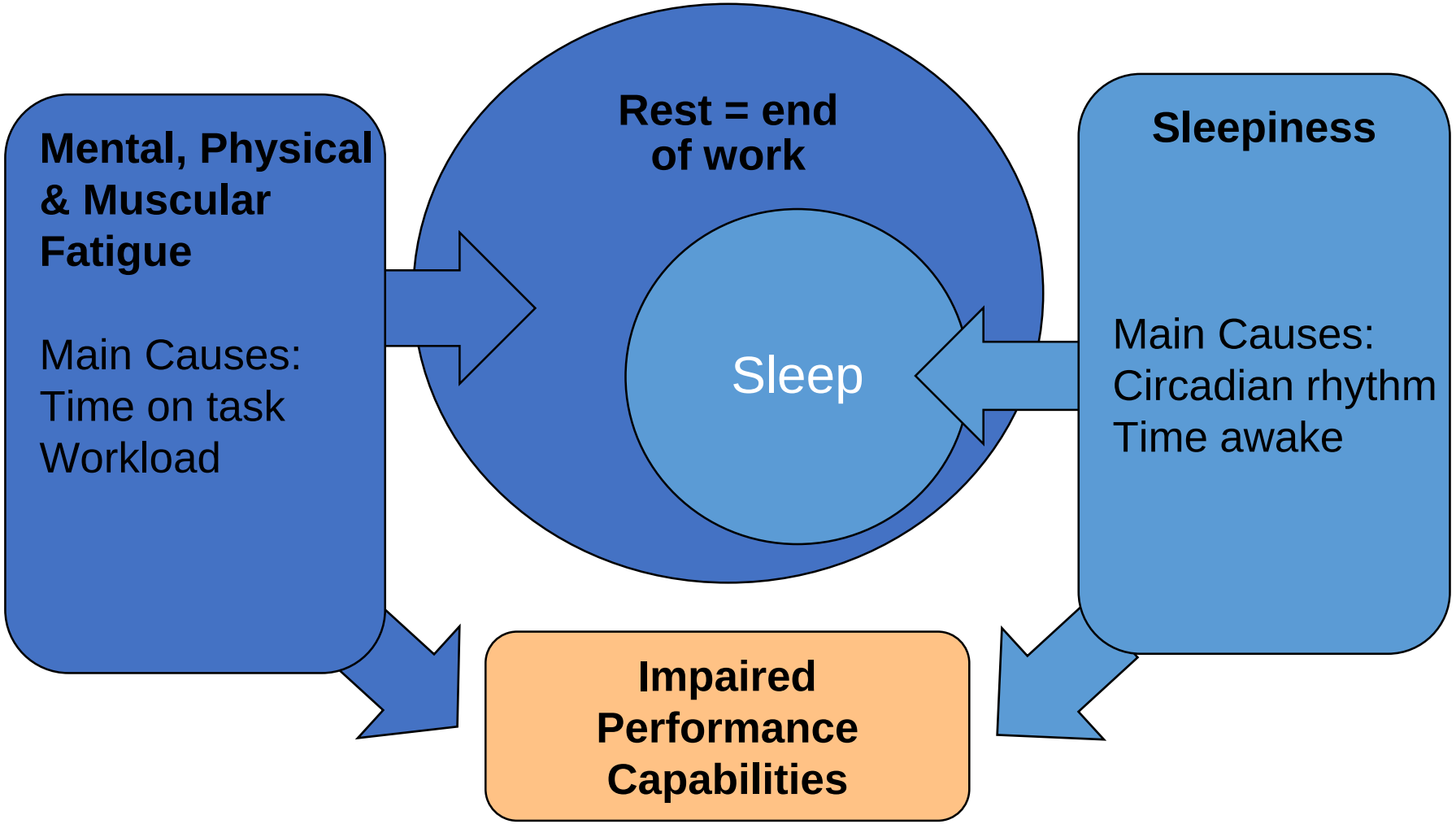
ACCIDENTS ATTRIBUTED TO FATIGUE

	Airline and location	Date
1	American International Airways, Guantanamo Bay, Cuba	18 August 1993
2	Continental Express, Pine Bluff, Arkansas	29 April 1993
3	Korean Airlines, Nimitz Hill, Guam	6 August 1997
4	American Airlines, Little Rock, Arkansas	1 June 1999
5	FedEx, Tallahassee, Florida	26 July 2002
6	Georgian Express Ltd., Ile Pelée, Ontario	17 January 2004
7	MK airlines, Halifax, Canada	14 October 2004
8	Corporate Airlines, Kirksville, Missouri	19 October 2004
9	Shuttle America, Cleveland, Ohio	18 February 2007
10	Colgan Air, Buffalo, New York*	12. February 2009

COLGAN AIR ACCIDENT

What is fatigue?

« FATIGUE IS A BIOLOGICAL DRIVE FOR A RECUPERATIVE REST »



Adapted from Folkard, 2008

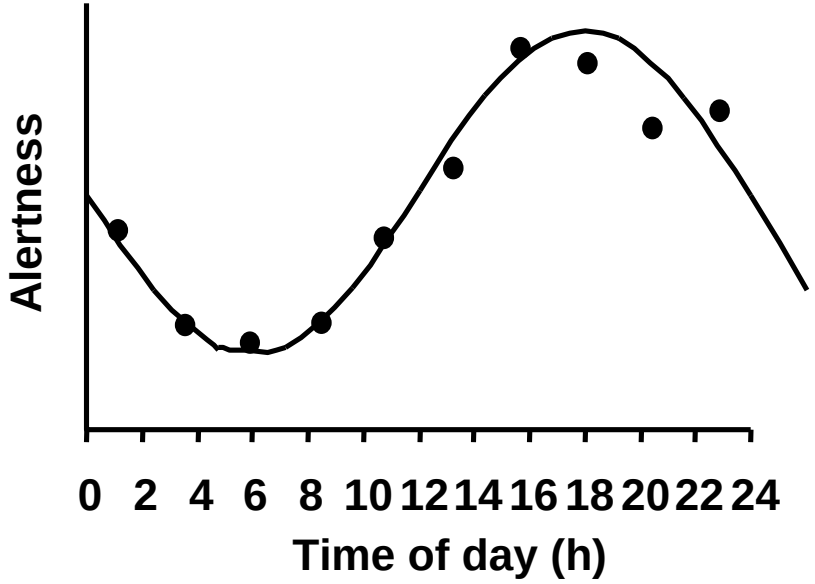
FATIGUE DEFINITION (FRMS GUIDE, ICAO 2011)

A physiological state of reduced mental or physical performance capability resulting from **sleep loss** or **extended wakefulness**, **circadian phase**, or **workload** (mental and/or physical activity) that can impair a crew member's **alertness** and **ability to safely operate an aircraft or perform safety related duties**.

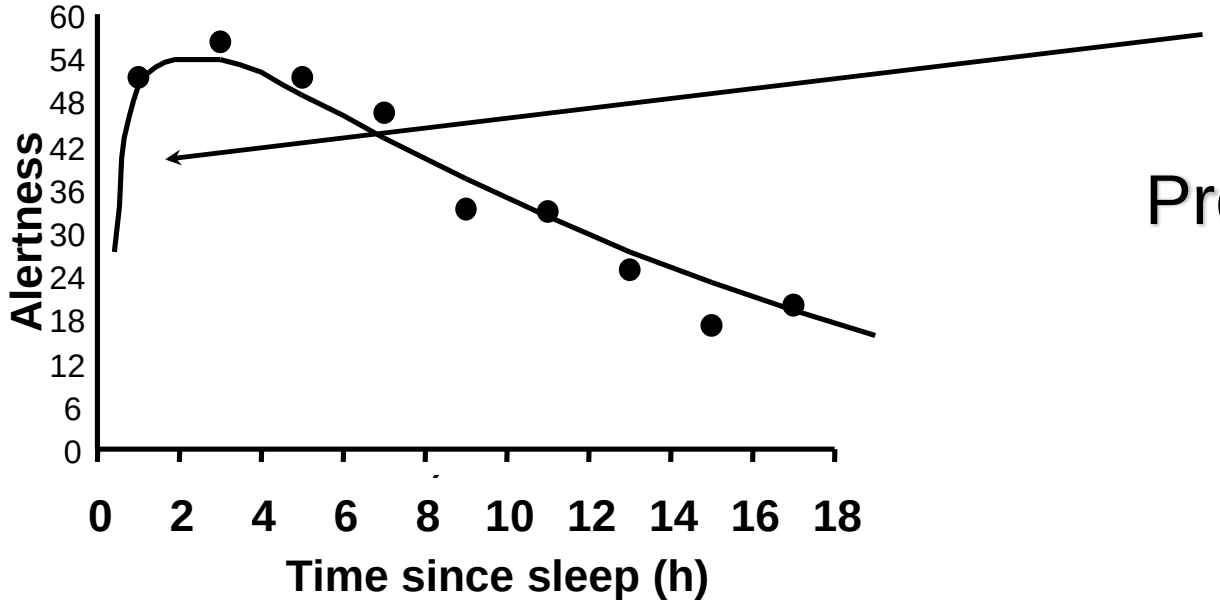
MAIN FATIGUE FACTORS IN AVIATION

- Irregular hours of work
- Long duty times
- Jet lag
- Workload
- Monotony

ALERTNESS COMPONENTS: THE 3-PROCESS MODEL



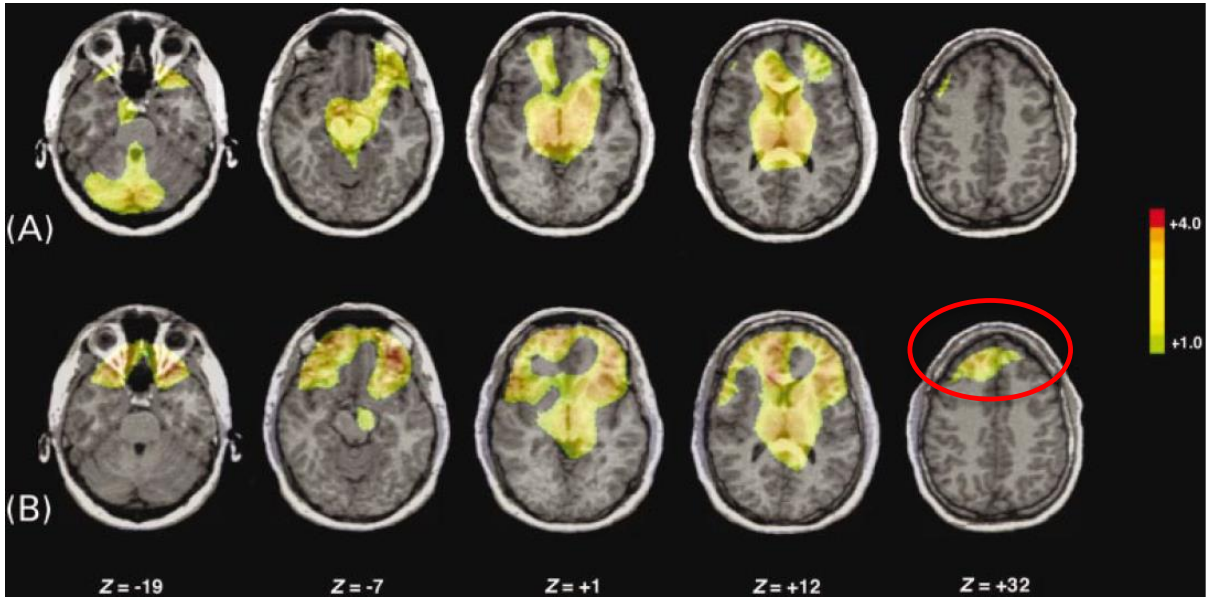
Process C (Clock)



Process W (Waking)

Process S (sleep)

BRAIN ACTIVATION AFTER AWEKENING (PROCESS W)



5 mn after awakening

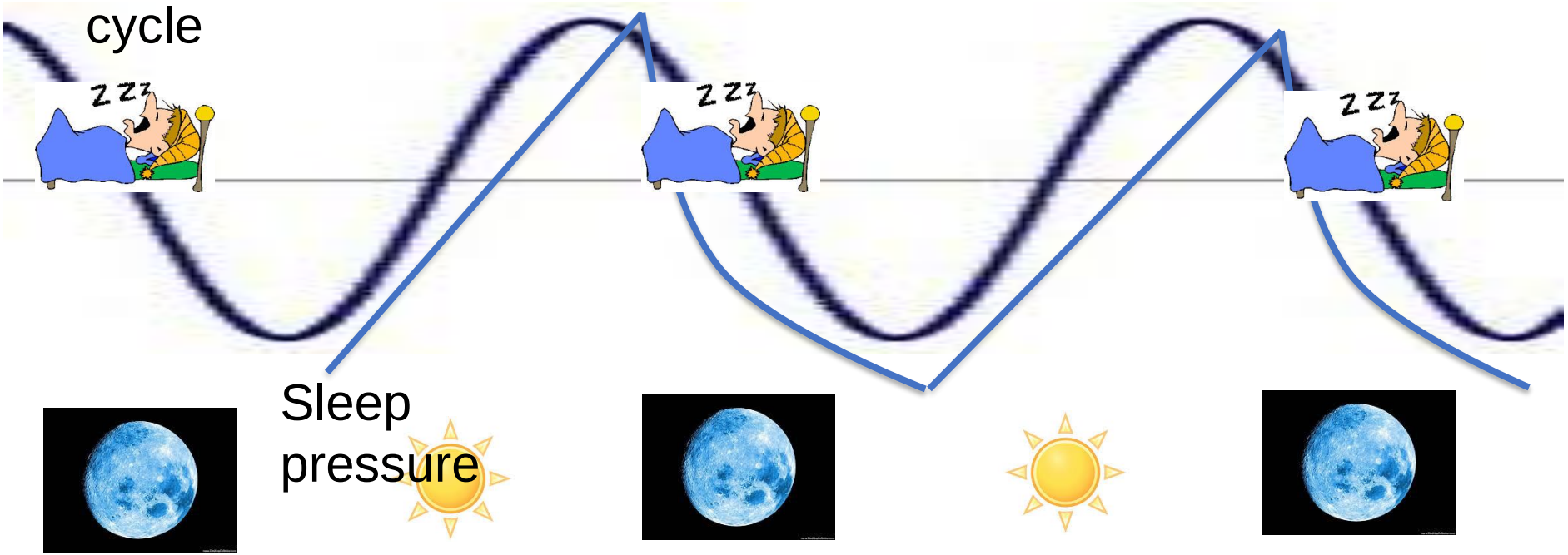
20 mn after awakening

- The prefrontal cortex takes longer to come "on-line" following sleep than other areas of the brain,
- Prefrontal cortex is involved in executive functions, inhibition processes, problem solving and divergent thinking

DAYTIME WORK, NIGHT SLEEP

Process C and S are synchronized

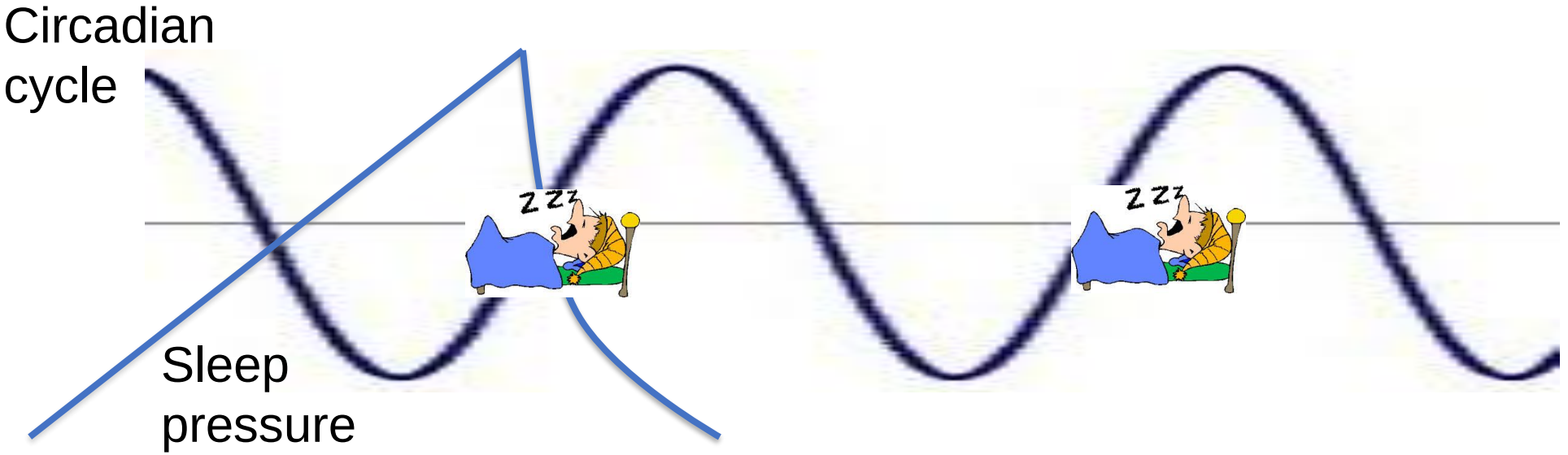
- Good nightime sleep the night
- High daytime alertness



NIGHT WORK, DAY SLEEP

Process C and S are desynchronized

- Poor daytime sleep
- Low nightime alertness

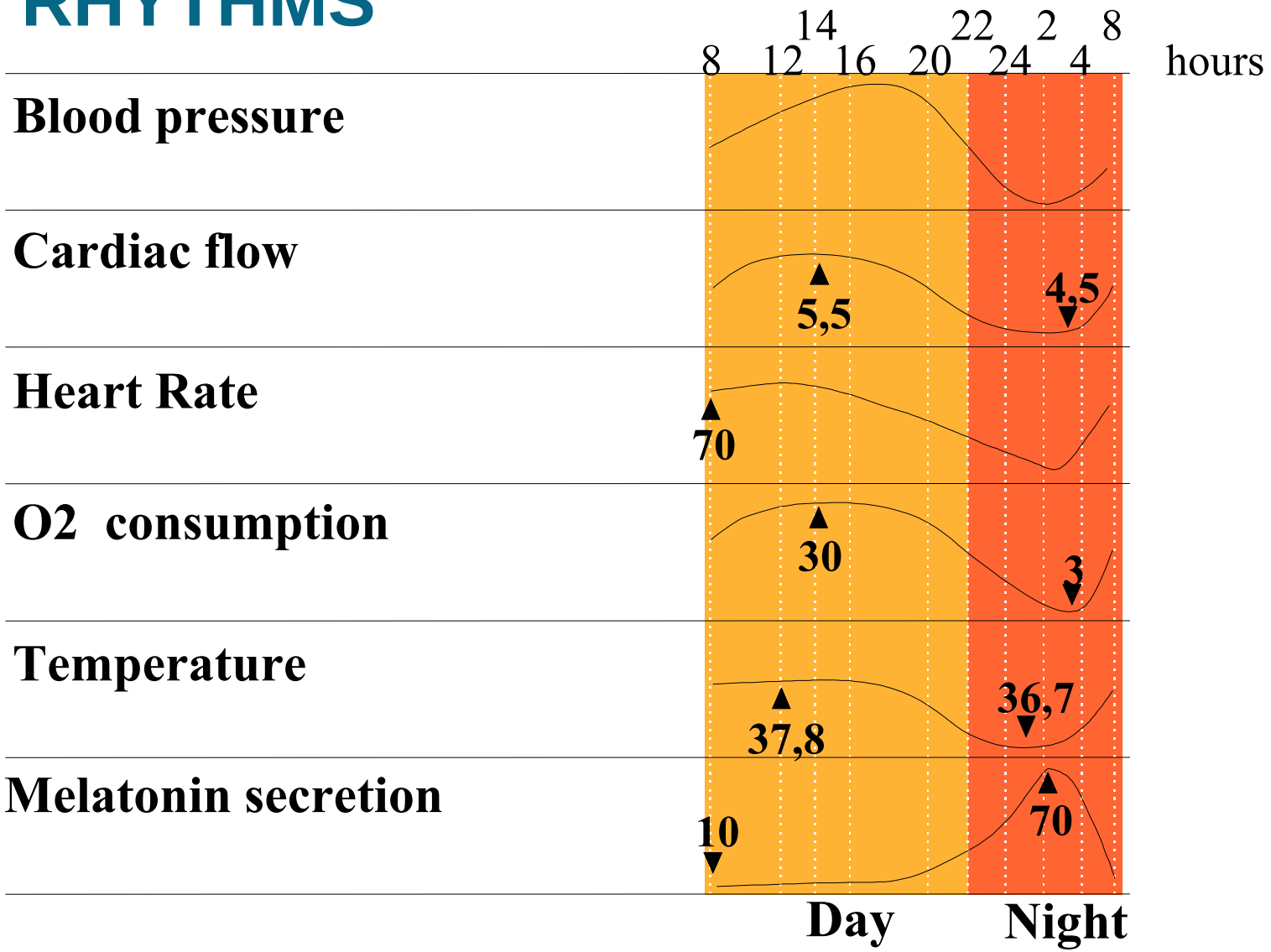




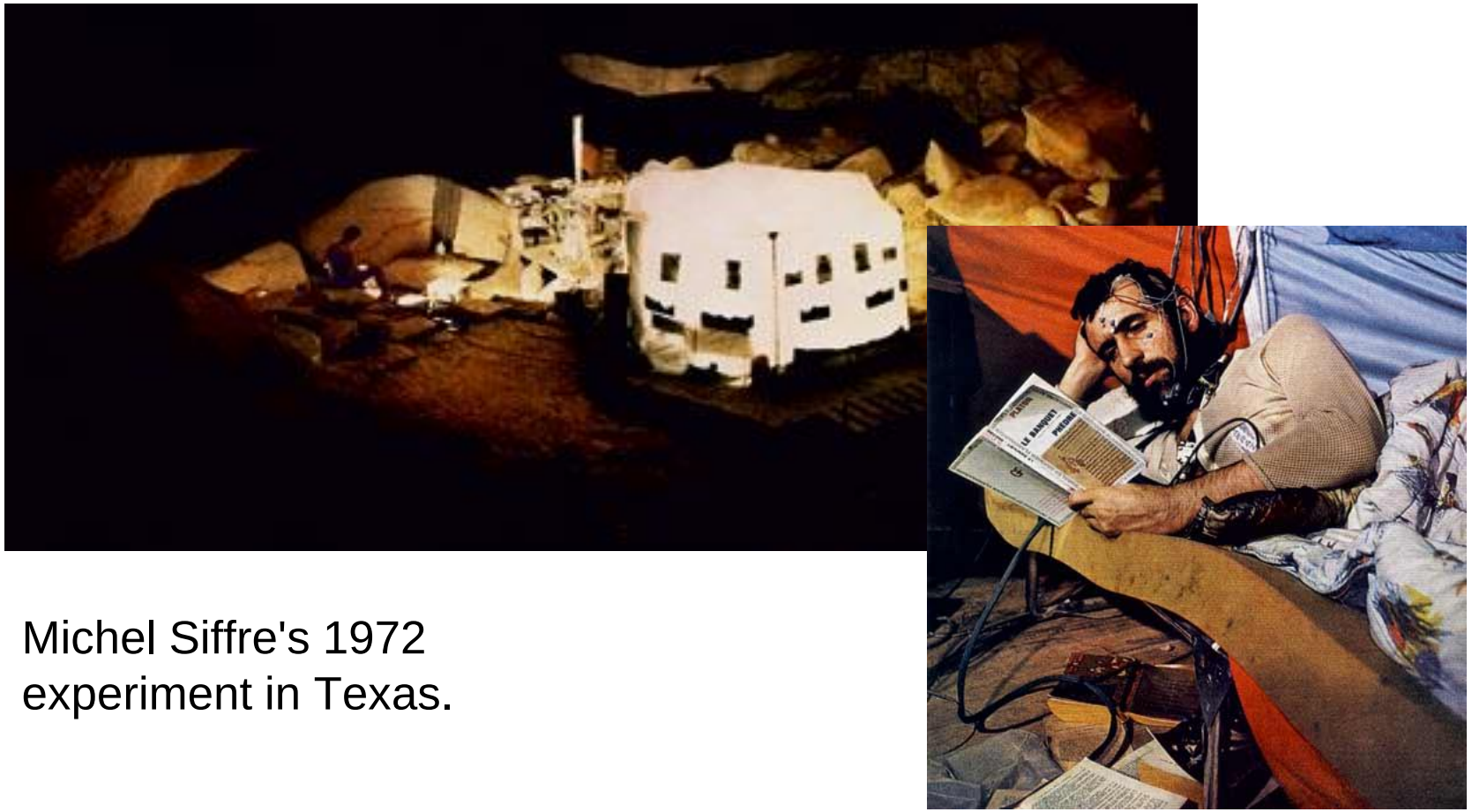

BIOLOGICAL RYTHMS

Shorter	← Frequency →	Longer
Ultradien	Circadian	Infradian
Fraction of second to few hours (<20 h)	Around 24 hours (20-28 h)	Higher than 24 hours (>28 h)
- Brain waves - Heart rate - Respiration - Vigilance - …	- Sleep-wake - Vigilance - Performances - Hormonal secretion - Temperature - …	- Menstrual cycle - Hormonal secretion - …

CIRCADIAN RHYTHMS



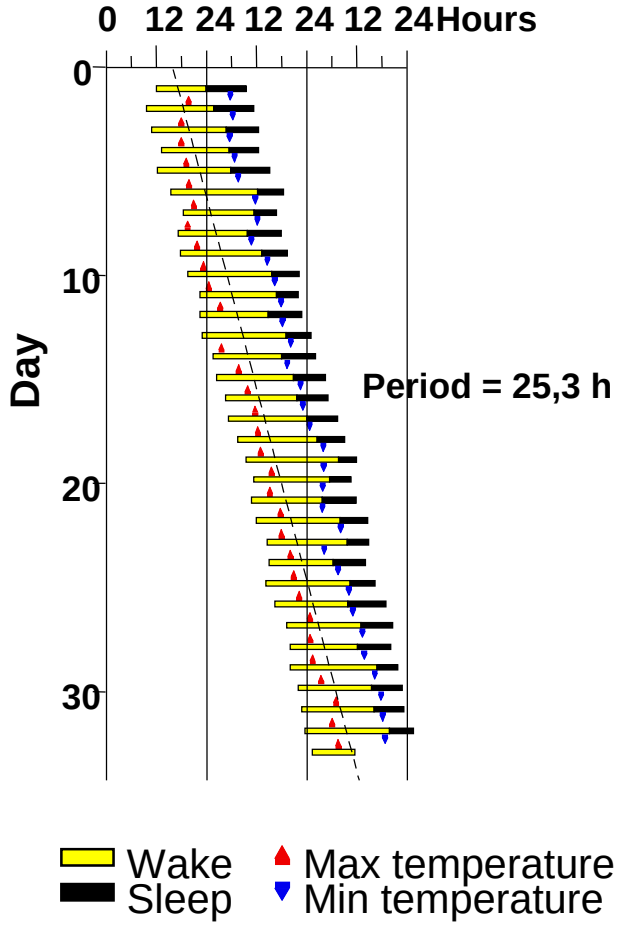
THE DISCOVERY OF BIOLOGICAL RHYTHMS: TEMPORAL ISOLATION



Michel Siffre's 1972 experiment in Texas.

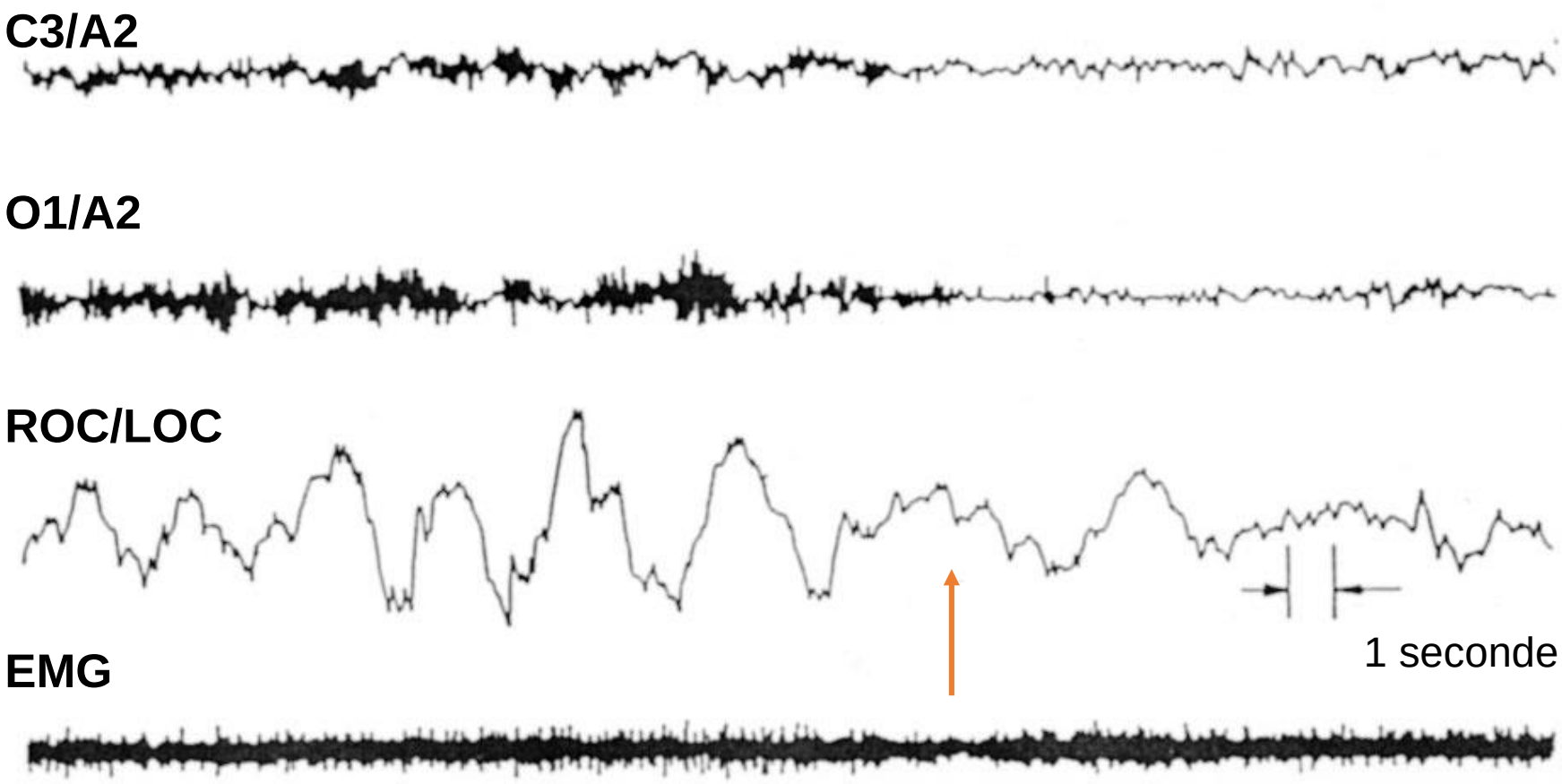
CIRCADIAN RHYTHMS

- In absence of time cues, the rhythms persists: they are internally controlled by a “clock”
- Free running is the natural tendency for 24-hour cycles to extend in the absence of external time-givers.
- This is why it is easier to delay bedtimes and rising times than to advance them.

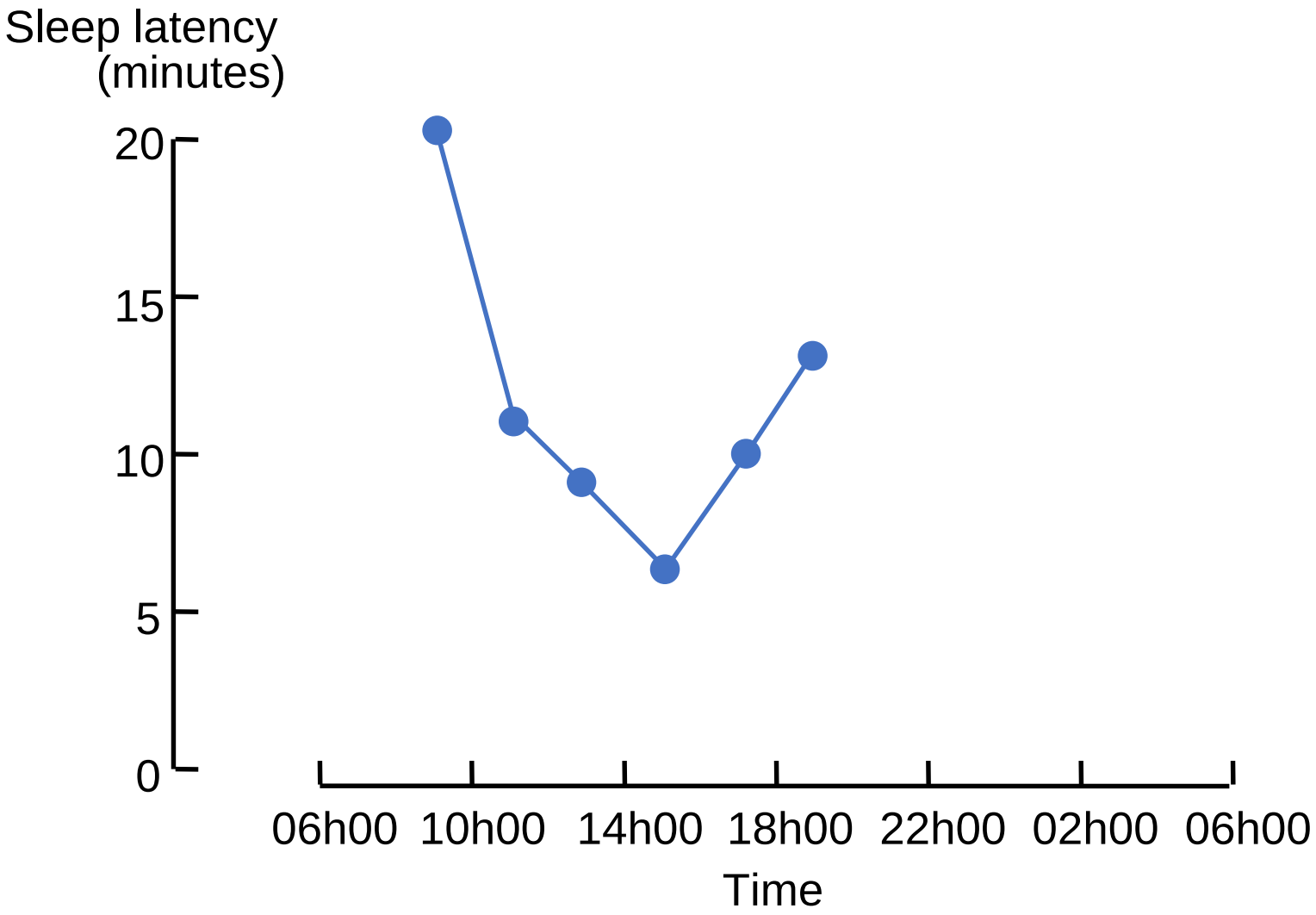


Sleep-wake and temperature cycle without time cues (Wever, 1979)

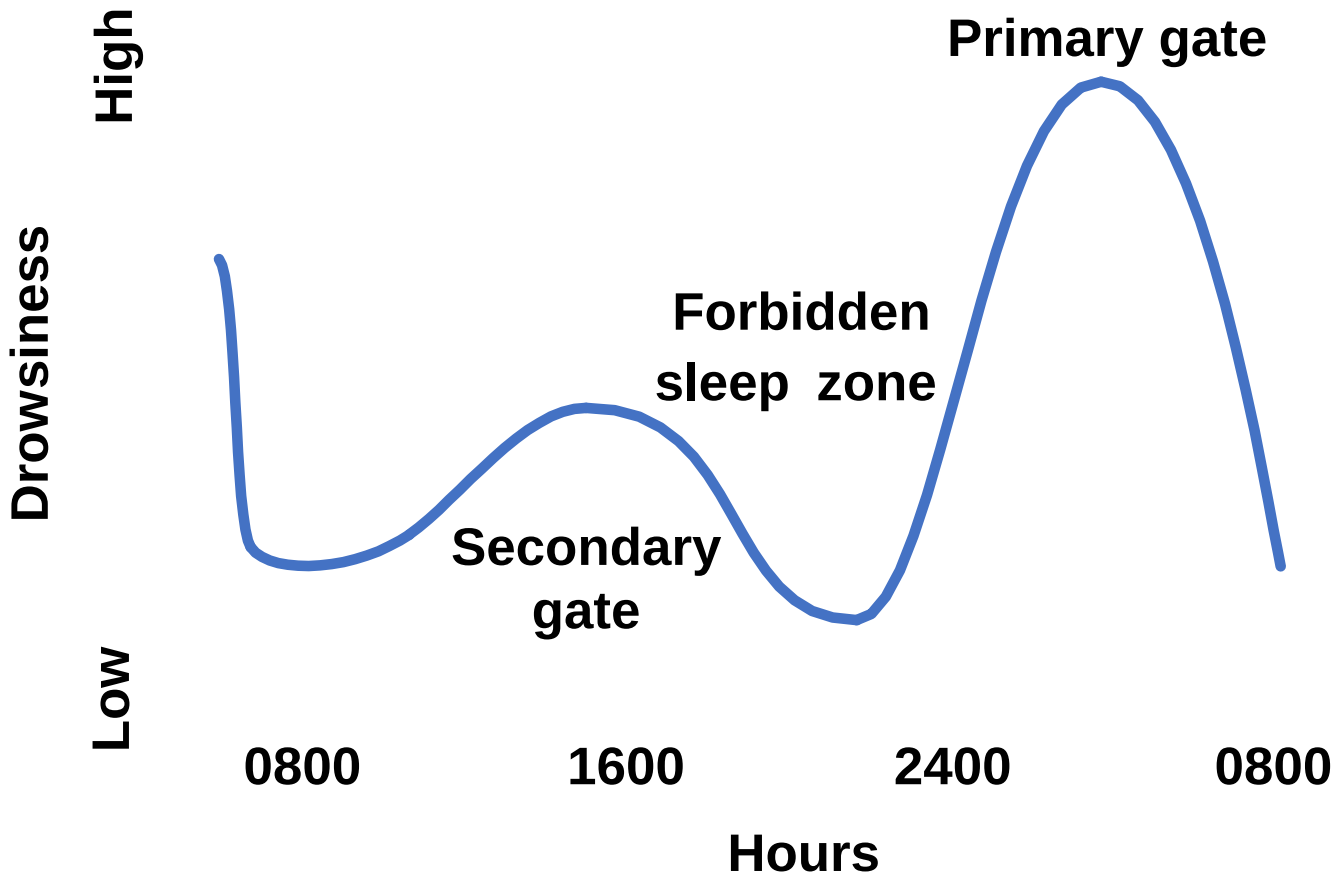
MULTIPLE SLEEP LATENCY TEST (MSLT)



SLEEP LATENCY



12 HOURS RHYTHM OF SLEEPINESS



Schematic representation of time periods favoring sleep onset
(taken from Stampi, 1989)

SLEEP

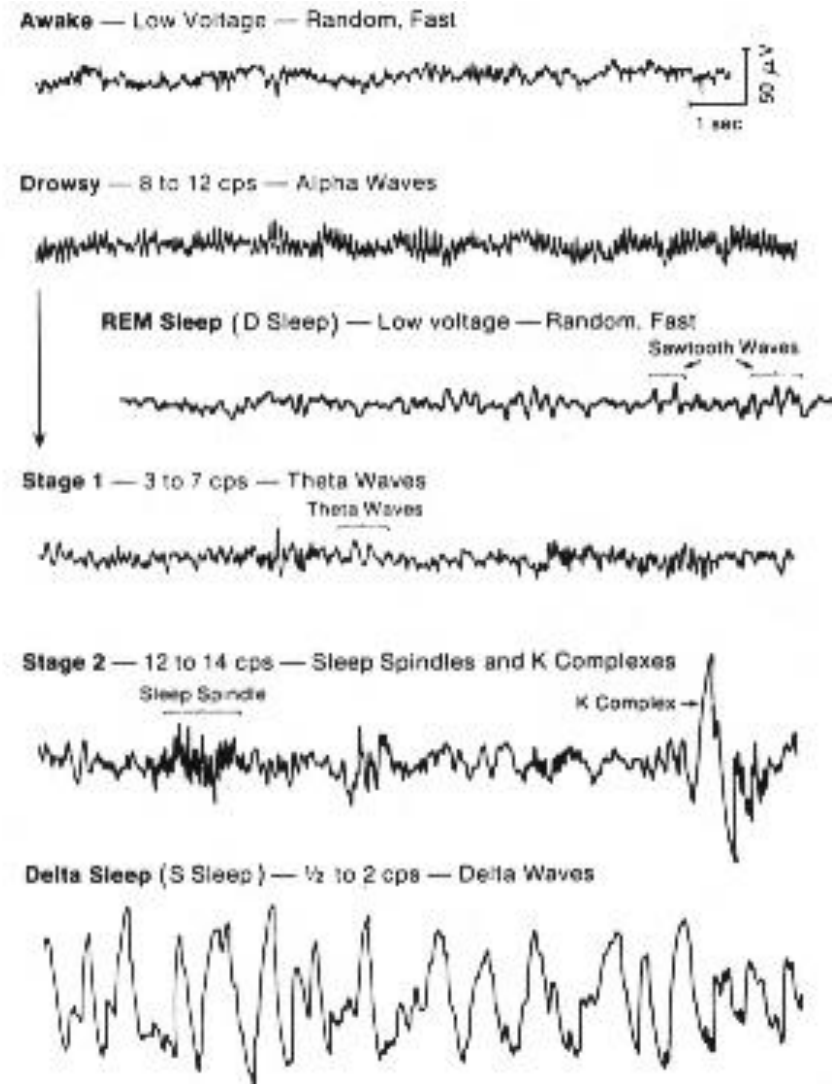
Polysomnographic study of sleep, recording of cerebral activity, muscular tone and eye movements, allows the various increasing depth stages to be separated:

- Stage 1: sleep onset,
- Stage 2: light sleep,
- Stage 3 and 4: deep slow-wave sleep,
- Stage 5: Rapid Eye Movement (REM) sleep.

Essential for physical recovery

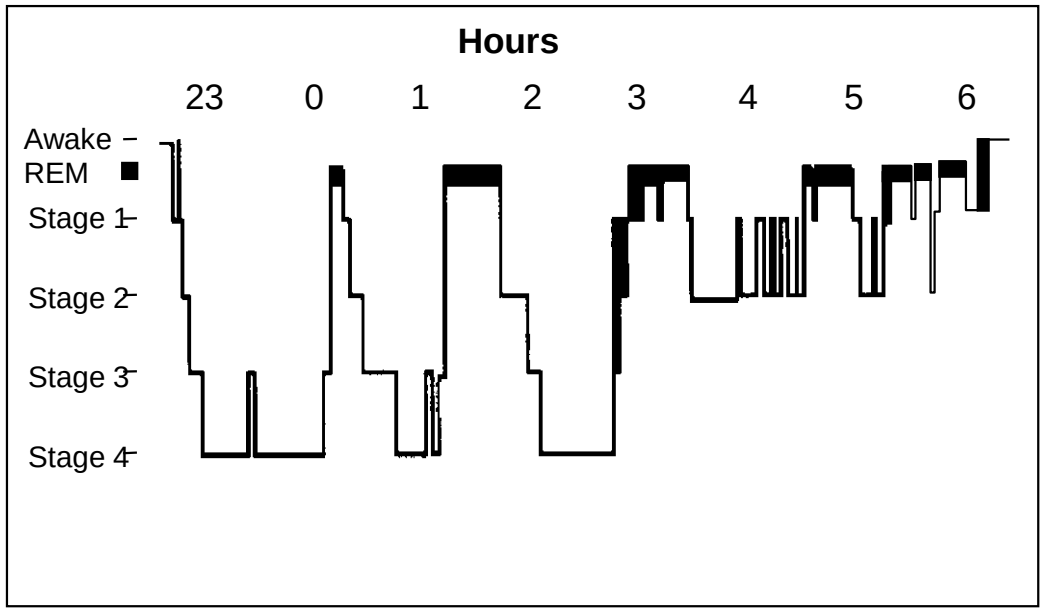
Essential for mental recovery

EEG DURING SLEEP



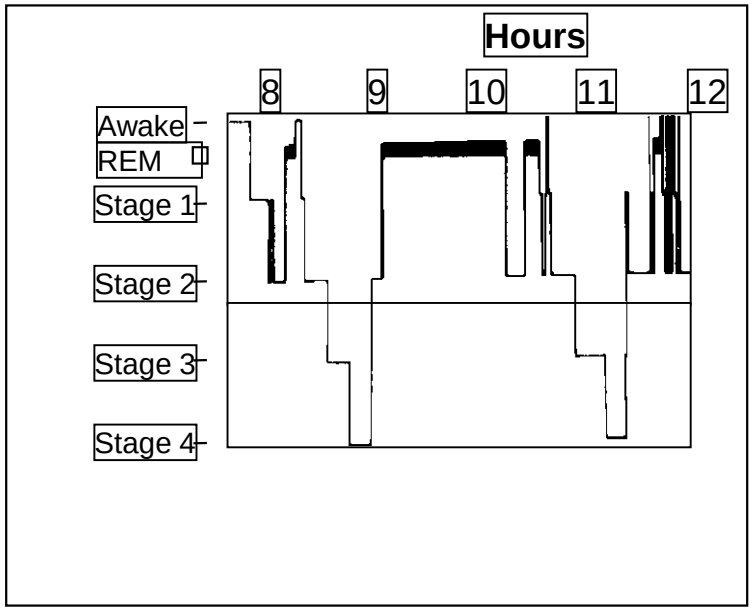
SLEEP STRUCTURE

Normal



Disturbed

(e.g.: day sleep)



Recovery

REM sleep

Stage 1 } **Light sleep**

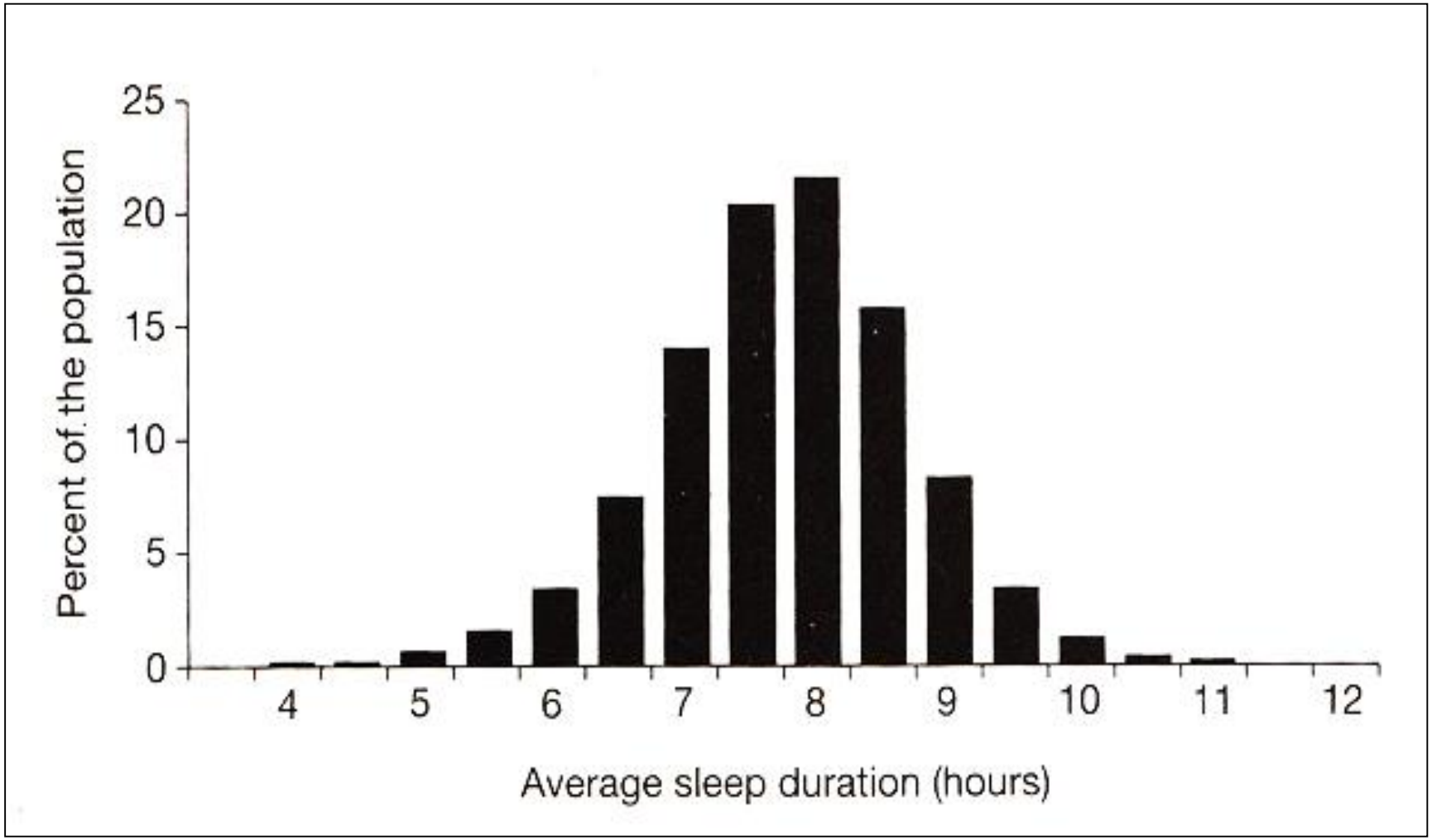
Stage 2

Stage 3 } **Deep sleep**

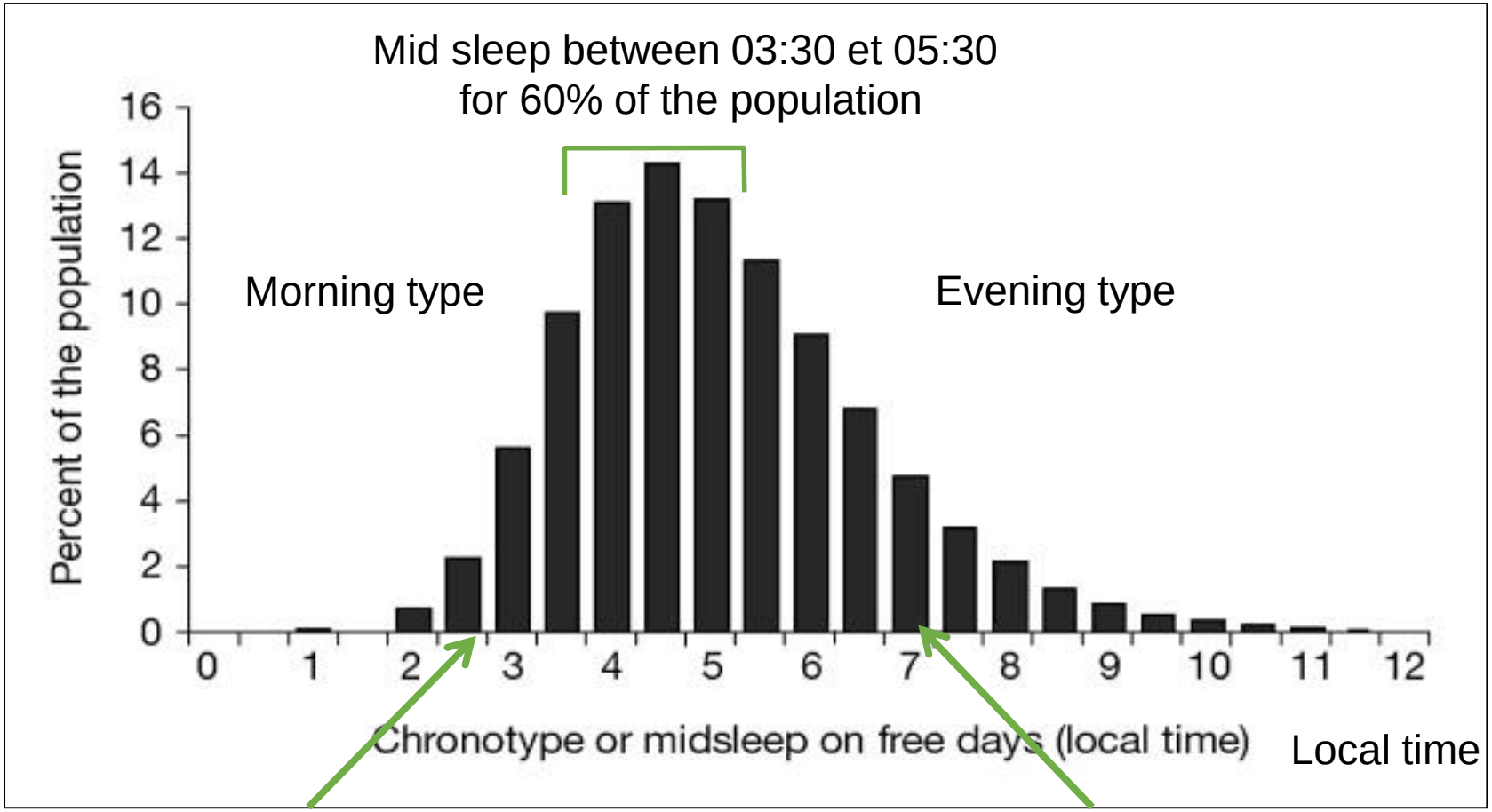
Stage 4

Fatigue

SLEEP TIME DISTRIBUTION IN THE GENERAL POPULATION



DISTRIBUTION OF THE MORNING/EVENING TYPE



At 2:30 am, a person who sleeps 7 hours, will fall asleep at 11pm and will wake-up at 6am

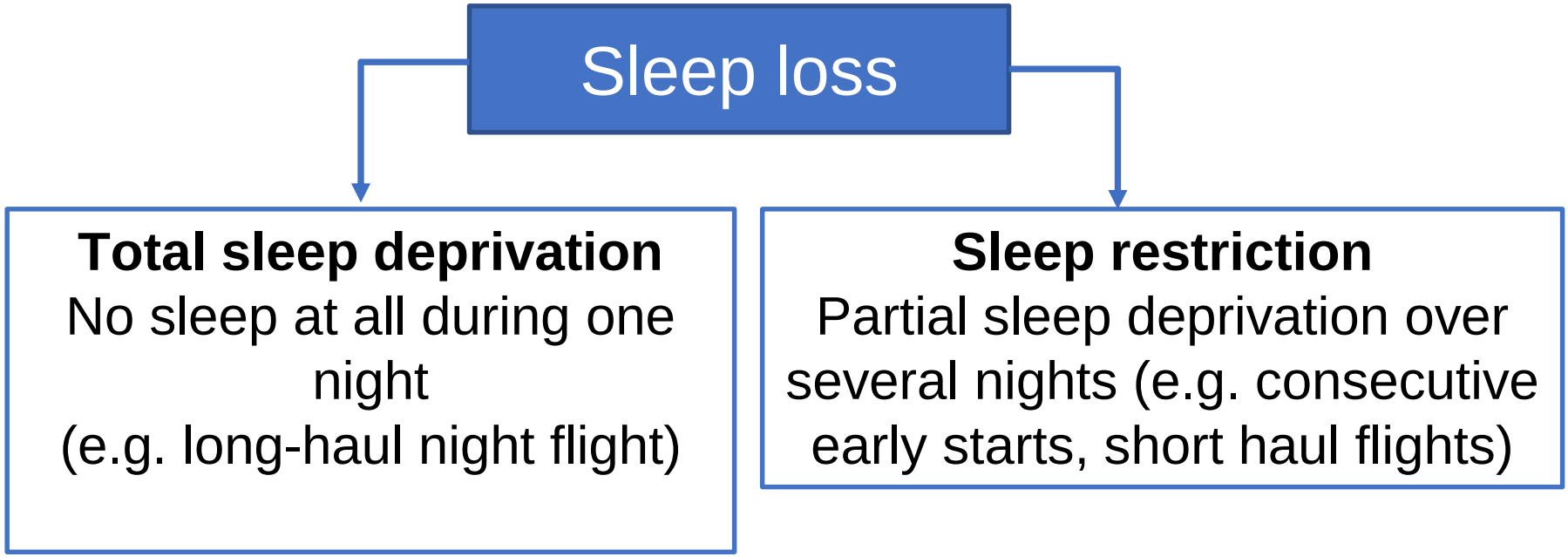
At 7:00 am, a person who sleeps 7 hours, will sleep at 3:30am and will wake-up at 10:30am

Sleep changes with age

	20	40	60	80
Sleep time (mn)	450	417	383	350
Sleep latency (mn)	16	17	18	19
Sleep efficiency (%)	95	89	84	79
Stage 1 (%)	5.8	6.2	6.8	7
Stage 2 (%)	48	51	53.5	56
Slow Wave Sleep (%)	20	15	10	8
REM (%)	21.8	20.8	19.6	18.6
REM latency (mn)	100	84	70	60
Nocturnal arousals (mn)	14	26	43	77

Carrayon et al, 2004

Sleep deprivation versus sleep restriction



BLOOD ALCOHOL CONCENTRATION VS. SLEEP LOSS

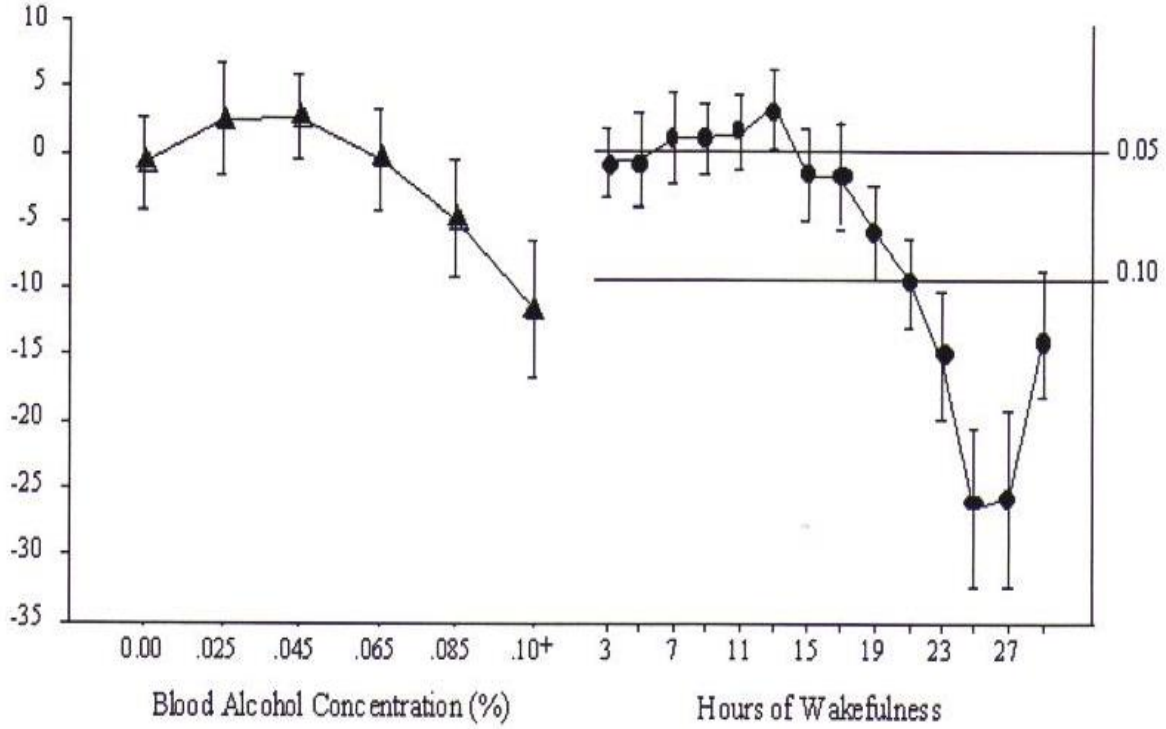


FIG. 1. Mean relative performance levels for the response latency component of the grammatical reasoning task in the alcohol intoxication (left) and sustained wakefulness condition. The equivalent performance decrement at a BAC of 0.05% and 0.10% are indicated on the right hand axis. Error bars indicate ± one s.e.m.

(Lamond and Dawson, 1999)

SLEEP LOSS AND PERFORMANCE

Effects on cognitive performance

- Lack of concentration,
- Periods of inattention,
- Reduction in alertness level
- Slow (re)actions,
- Alteration in short-term memory,
- Loss of critical analysis and advocacy,
- Interpretation errors,
- Visual illusions,
- Disorientation in time and space.

Effects on Mood

- Feelings of fatigue,
- Depressed state,
- Irritability,
- Loss of interest in people and events,
- Increasing and irresistible longing for sleep.

NTSB reports on pilots falling asleep

Feds want to rewrite rules to curb fatigue

By Alan Levin
USA TODAY

WASHINGTON — Two airline pilots fell asleep while cruising over Hawaii last February, flying past their destination toward open ocean for 18 minutes before waking up and returning for a safe landing, federal accident investigators revealed Tuesday.

That incident and an accident in Traverse City, Mich., last year highlight the need for more comprehensive rules to stem the growing list of crashes attributed to the lengthy hours that pilots routinely work, the National Transportation Safety Board (NTSB) said. Crashes linked to fatigue have killed 249 people since 1997, according to NTSB records.

By Marco Garcia, AP

Fatigue to blame: Two Go Airlines pilots working a "demanding" schedule fell asleep and flew past their destination February.

"It's an insidious issue," NTSB Chairman Mark Rosenker said. "Many times the pilots themselves don't recognize that they are fatigued when they get into that cockpit."

The NTSB voted to recommend that federal aviation regulators and airlines use fatigue studies to rewrite the rules for how long pilots can legally fly. Currently, federal law allows pilots to work up to 16 hours a day, including up to eight hours behind the controls, and loopholes allow longer days in some situations.

Air-traffic controllers frantically radioed Go Airlines Flight 1002 from Honolulu to Hilo, Hawaii, for 18 minutes on Feb. 13, but got no response from the pilots, said NTSB investigator Jana Price.

In the safety board's first disclosure of details from the investigation, Price said both pilots "unintentionally fell asleep" as the Bombardier CRJ-200 jet flew at 21,000 feet. The jet carried 40 passengers.

The two pilots had been flying together for three arduous days "that involved early start times" and a "demanding" sequence of short flights, Price said. Since the incident, the captain had been diagnosed with severe obstructive sleep apnea, she said. Apnea causes people to repeatedly wake up during the night and has been linked to poor work performance and accidents.

In a separate investigation, the NTSB concluded that a regional airline crash last year in Traverse City was probably triggered by fatigue. Pinnacle Airlines Flight 4712 skidded off the end of a snowy runway on April 12, 2007, after landing in the early hours of the morning. None of the 49 passengers, two pilots and a flight attendant were injured.

The NTSB found that the pilots of the Bombardier CRJ-200 should never have attempted the landing.

The runway was too slick to land under the airline's rules, but the pilots failed to perform a basic landing calculation and missed other warning signs that the weather was deteriorating.

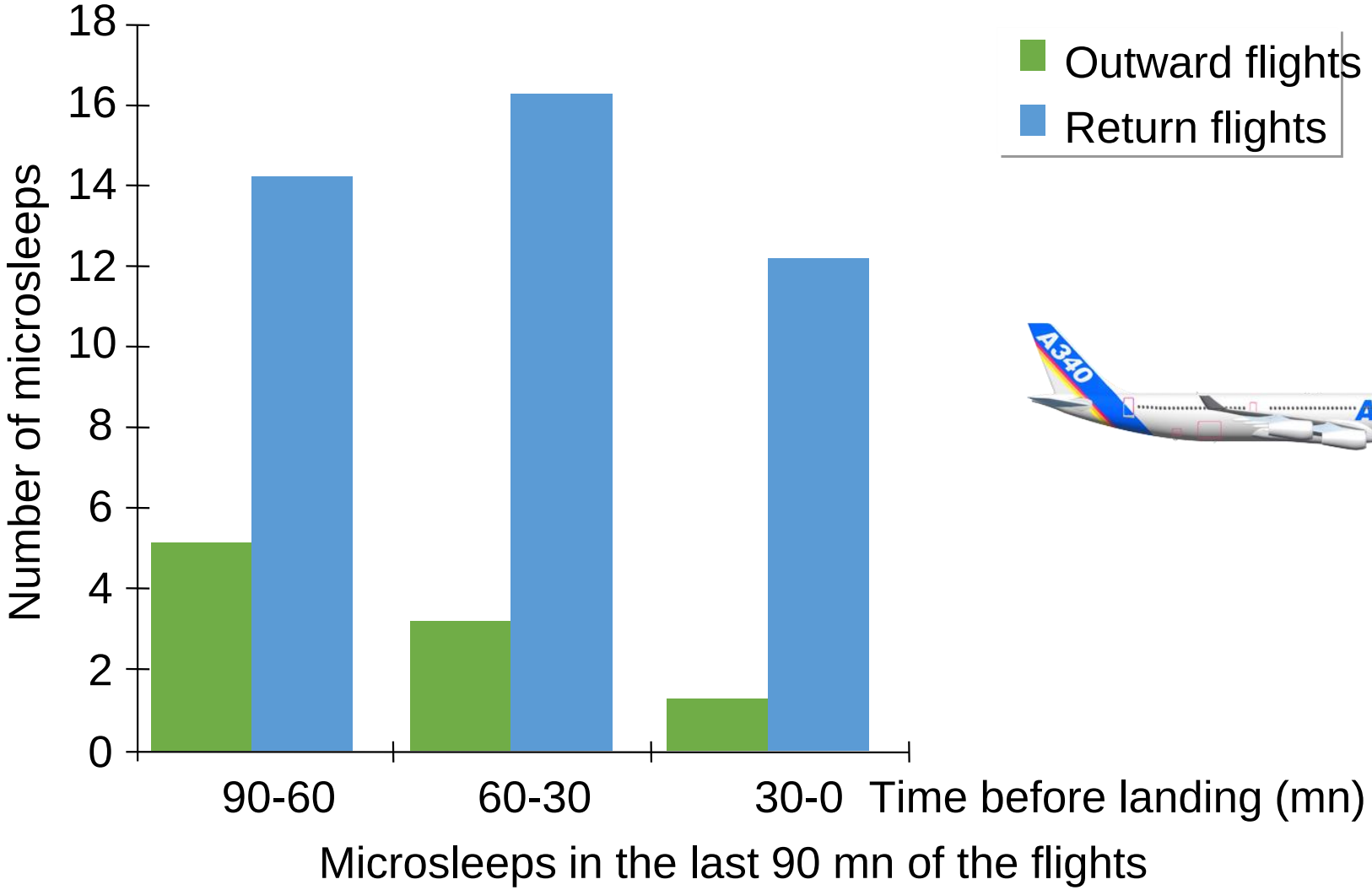
The accident happened after the pilots had worked 14 hours. The cockpit recorder overheard the pilots yawning and the captain made repeated references to being tired, the NTSB found.

The NTSB has been calling for reform of pilot work rules for decades. Several attempts to rewrite pilot work rules have failed in the face of opposition from airlines and pilot groups.

Contributing: Dennis Camire of Gannett News Service

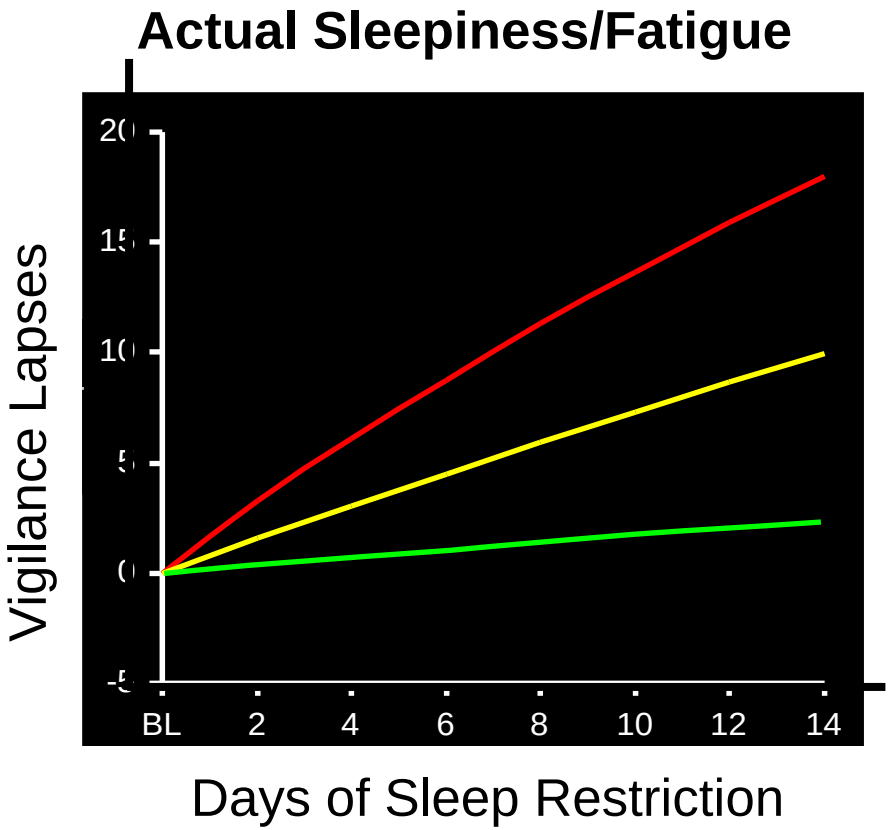
MICROSLEEPS (LATE SLEEPINESS) DURING LONG-RANGE FLIGHTS

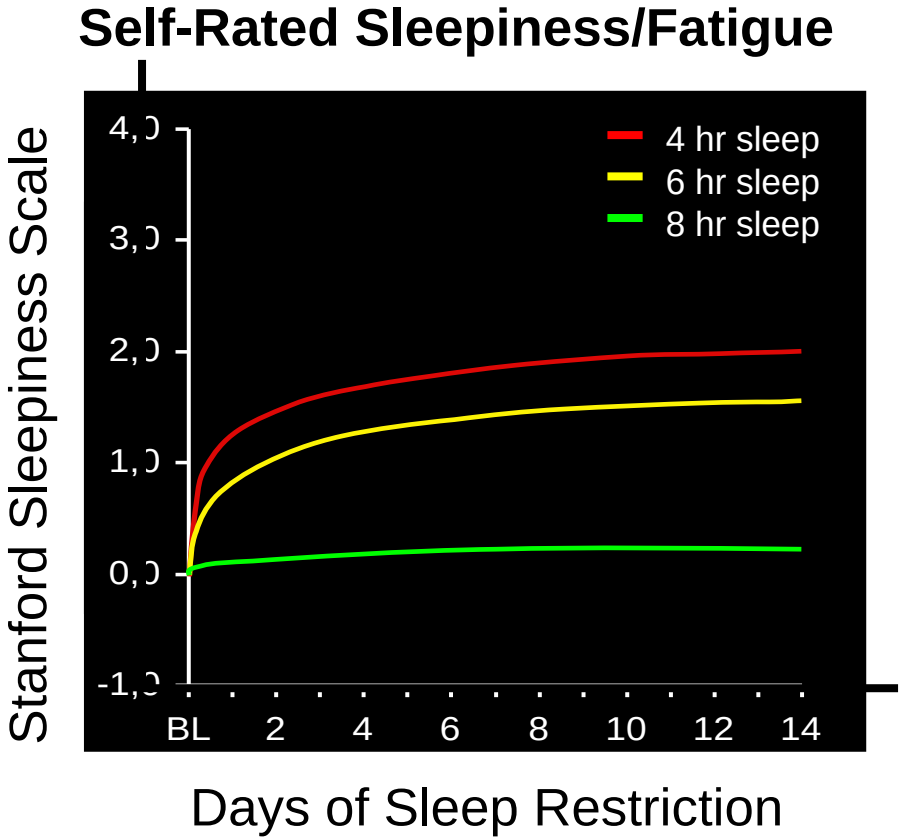
MICROSLEEPS DURING THE LAST PHASE OF LONG-HAUL FLIGHTS




DRIVECAM

SELF-ASSESSMENT OF CHRONIC FATIGUE IS NOT ACCURATE





Objective measures show fatigue progressively degrades cognitive performance

BUT

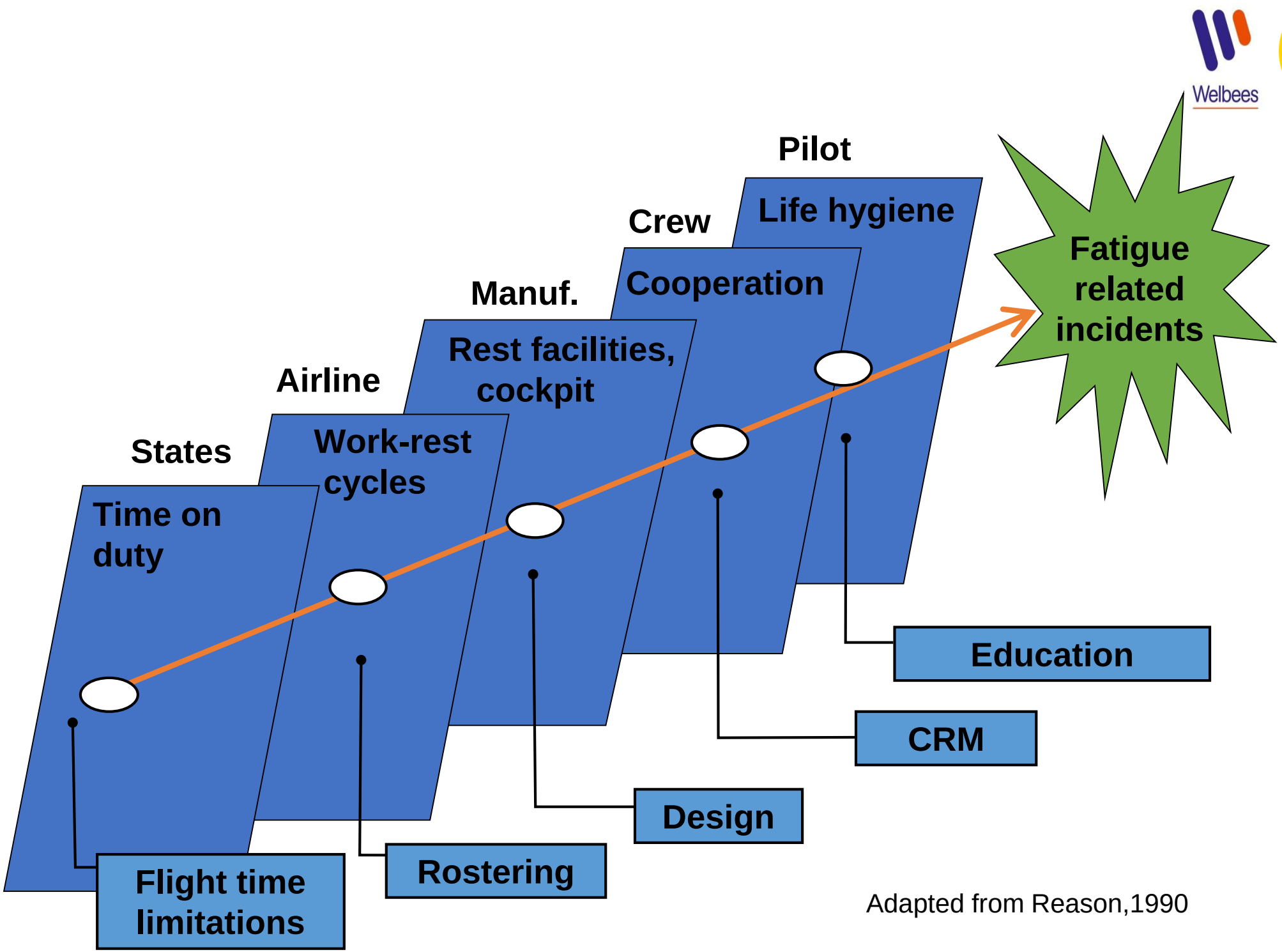
Self ratings of fatigue fail to recognize all but the initial fatigue effects!

Van Dongen, Maislin, Mullington, and Dinges (2003)

KEY POINTS

- Fatigue can kill especially if you are not aware of it
- We are programmed to sleep a certain amount in 24 hrs
- We are programmed to sleep at certain time of the day (night and early afternoon)
- Fatigue management should be considered gloabally: from the organizational to the individual level

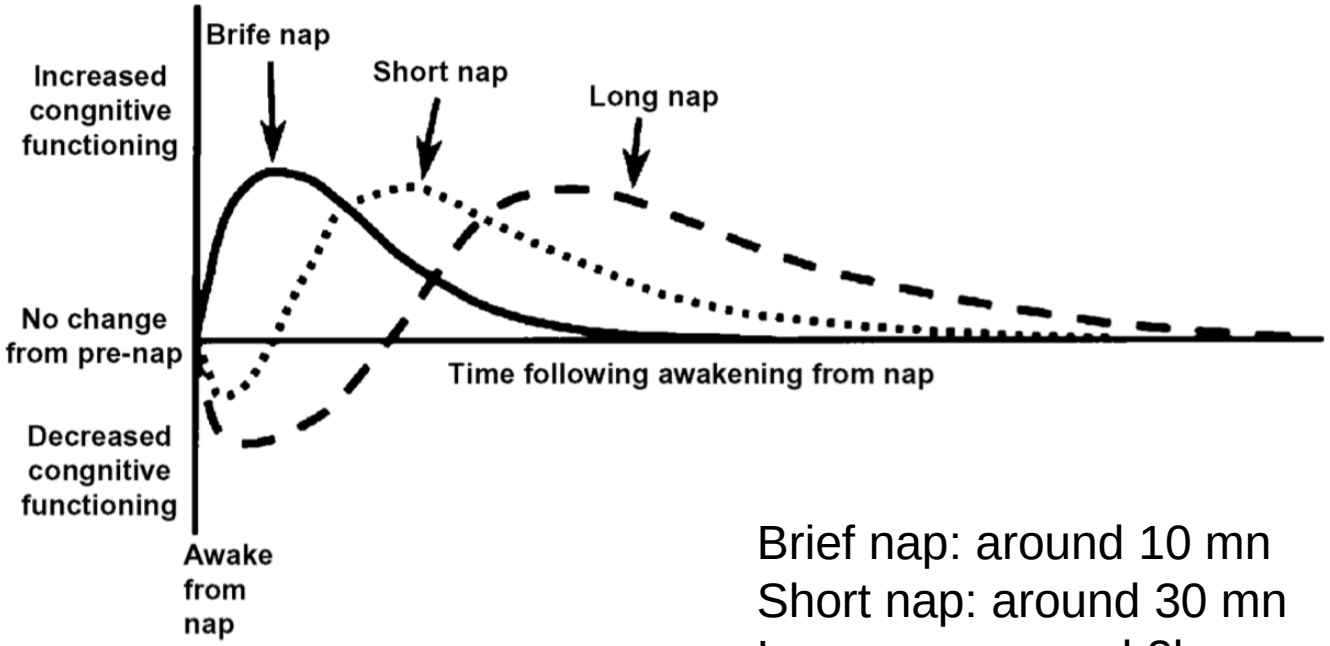
FATIGUE MANAGEMENT


Welbees
Pilot
Life hygiene
Crew
Cooperation
Manuf.
Rest facilities, cockpit
Airline
Work-rest cycles
States
Time on duty
Fatigue related incidents
Education
CRM
Design
Rostering
Flight time limitations
Adapted from Reason,1990

NAPPING

- Nap: any sleep period with a duration of less than 50% of the average major sleep period of an individual (ie. max 4 hours)
- May last a few minutes up to several hours
- Benefits: reduce subjective and objective sleepiness but can also improve cognitive functioning, psychomotor performance and enhance short-term memory and mood
- Alerting benefits comparable, and often higher, to other countermeasures against sleepiness and performance decrements (caffeine, modafinil,…)

Hypothetized benefits/risks of naps depending on their length



Brief nap: around 10 mn
Short nap: around 30 mn
Long nap: around 2h

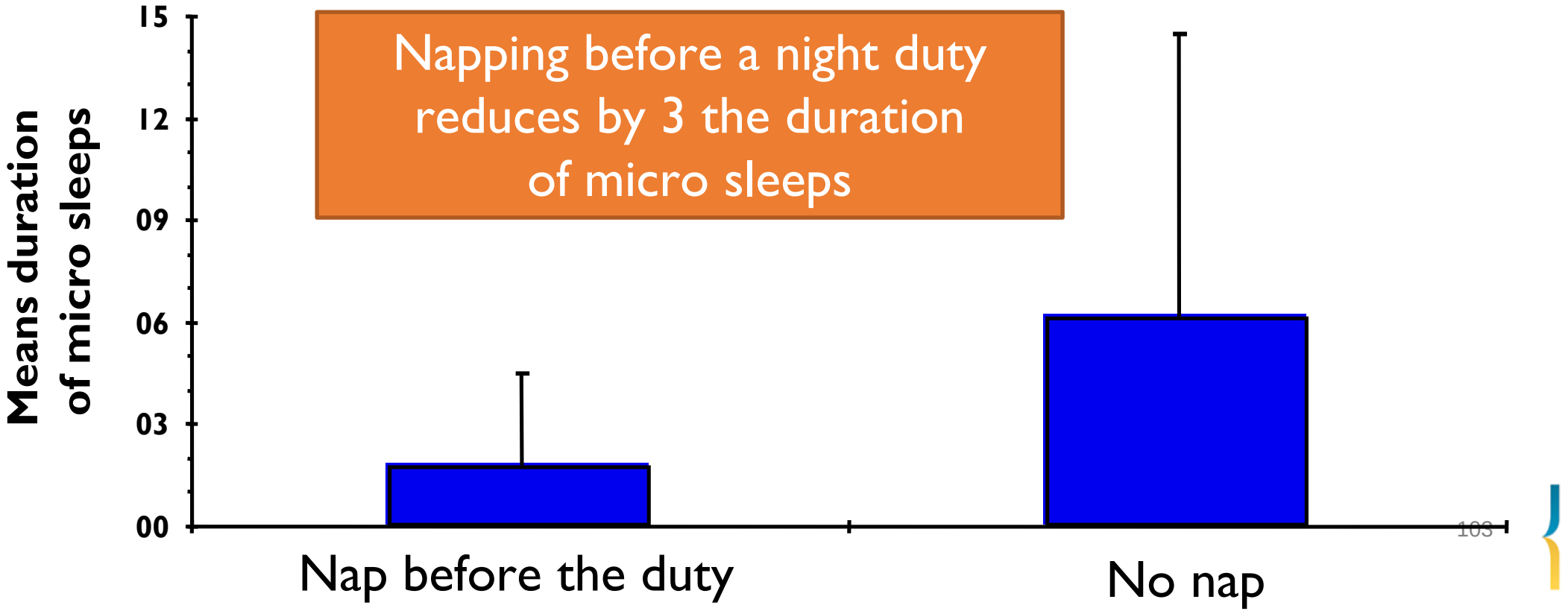
Lovato &
Lack, 2010

Effects of the timing of nap and prior sleep

- Naps taken during the post-lunch dip period have a greater recuperative value than naps taken in the early morning, late morning or evening
- Naps taken during the circadian nadir (0400 h) produce less recuperative value when compared to naps taken during the day or in the early hours of the morning.
- Naps taken after long periods of wakefulness (>18 h) are less effective and have shorter benefits than naps taken after shorter periods of wakefulness

BEFORE THE DUTY: SLEEP MANAGEMENT

- A sleep debt as low as possible
- A nap before starting a night shift is a prevention measure
  (10 to 30 minutes, never more)



Even better: Power Nap

Nap + caffeine = Power Nap

It is more effective than the regular nap in improving alertness

Power Nap Management:

- Caffeine intake before to prevent sleep inertia
- No more than 20 to 30 min long (before to enter a normal sleep cycle)
- Never on the job, only during a break!
- Not in your bed!

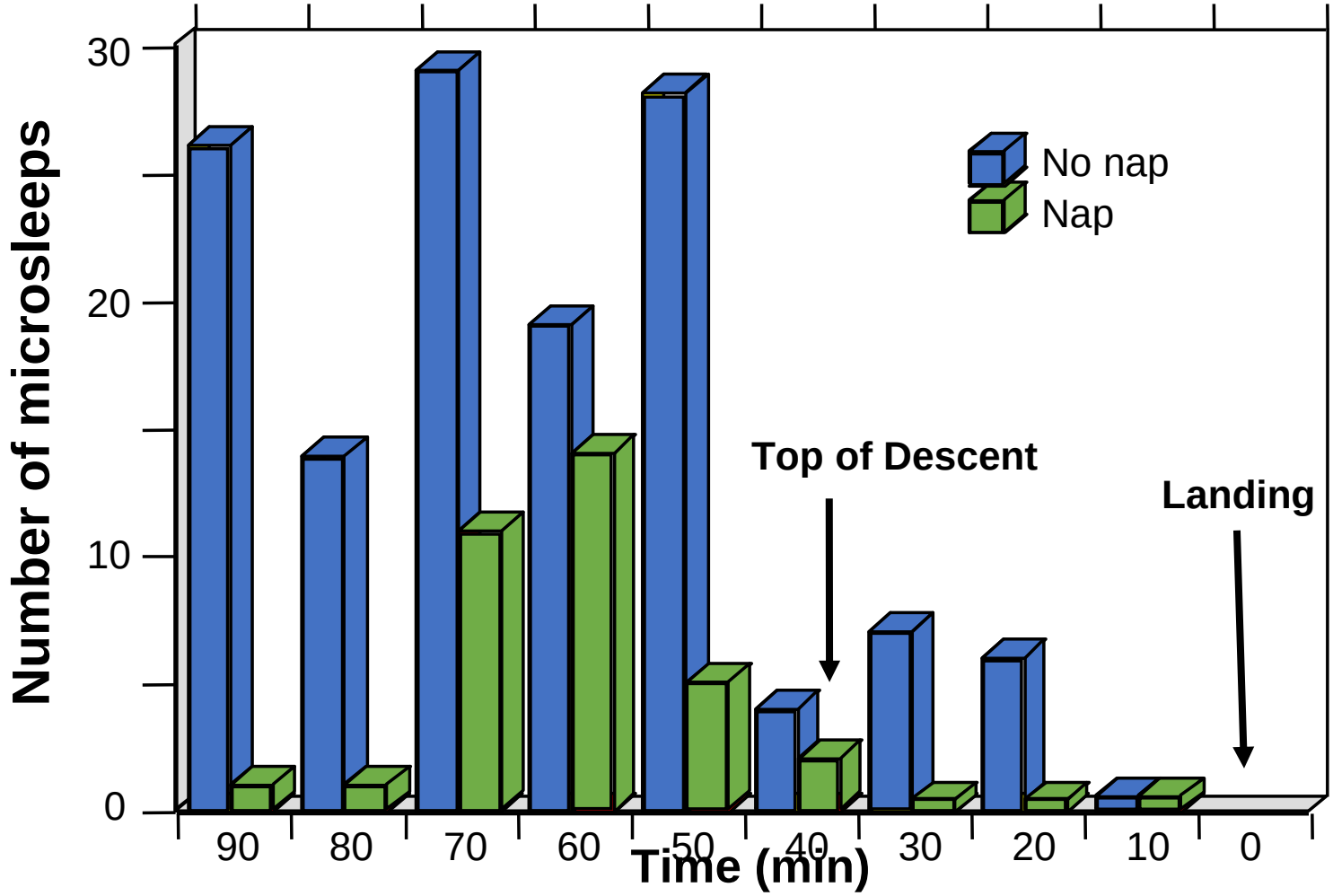
Effects of Power Nap:

Good alertness directly after awakening

Better memory recall after sleep

Reversing damages of sleep deprivation

INFLIGHT SLEEP MANAGEMENT: EFFECTS OF COCKPIT NAPPING ON MICROSLEEPS



(Graeber et coll., 1990)

The wrong nap

Long napping (over 30 min) may produce some side effects, « sleep inertia »

- Temporary reduced alertness and performance
- Generally last 20 min after a spontaneous wake up

Inertia may last much longer when wake-up occurs during slow wave sleep, especially when :

- Napping at night
- After a high sleep deprivation

→ Better to limit napping to 20 min

Napping is efficient but…

Sleepy pilot sent Air Canada jet into a dive after mistaking Venus for oncoming plane

"Under the effects of significant sleep inertia, the first officer perceived the oncoming aircraft as being on a collision course and began a descent to avoid it."

"He initially mistook the planet Venus for an aircraft, but the captain advised again that the target was at the 12 o'clock position and 1000ft below."

"When the FO saw the oncoming aircraft, the FO interpreted its position as being above and descending towards them."

"The FO reacted to the perceived imminent collision by pushing forward on the control column."

(Transportation Safety Board of Canada, 2012)

Air India, Mengalore, 22 May 2010

- The crash killed 158 people after the jet overran the runway and plunged off a cliff.
- The captain was captured **loudly snoring** on a cockpit recorder
- After waking, the captain did not respond when his co-pilot repeatedly urged him to abort the landing

KEY POINTS

- A large amount of knowledge has been developed on human fatigue over the last 20 years
- Most of this knowledge has been used to design education & training materials
- Most of current flight and duty time regulations do not take into account the available scientific knowledge
- Fatigue research is progressively evolving from individual to organizational management (FRMS)

STRESS

Stress: an archaic signal

- Our body has been adapted against external stressors so that our internal (homeostatic) balance would be restored and maintained.

- This mechanism is tailored in order to solve things in a fast and easy way with 2 possibilities: fight or flight

- This struggle of our body against stressors is called the **General Adaptive Syndrome** (G.A.S. *Selye 1936*)

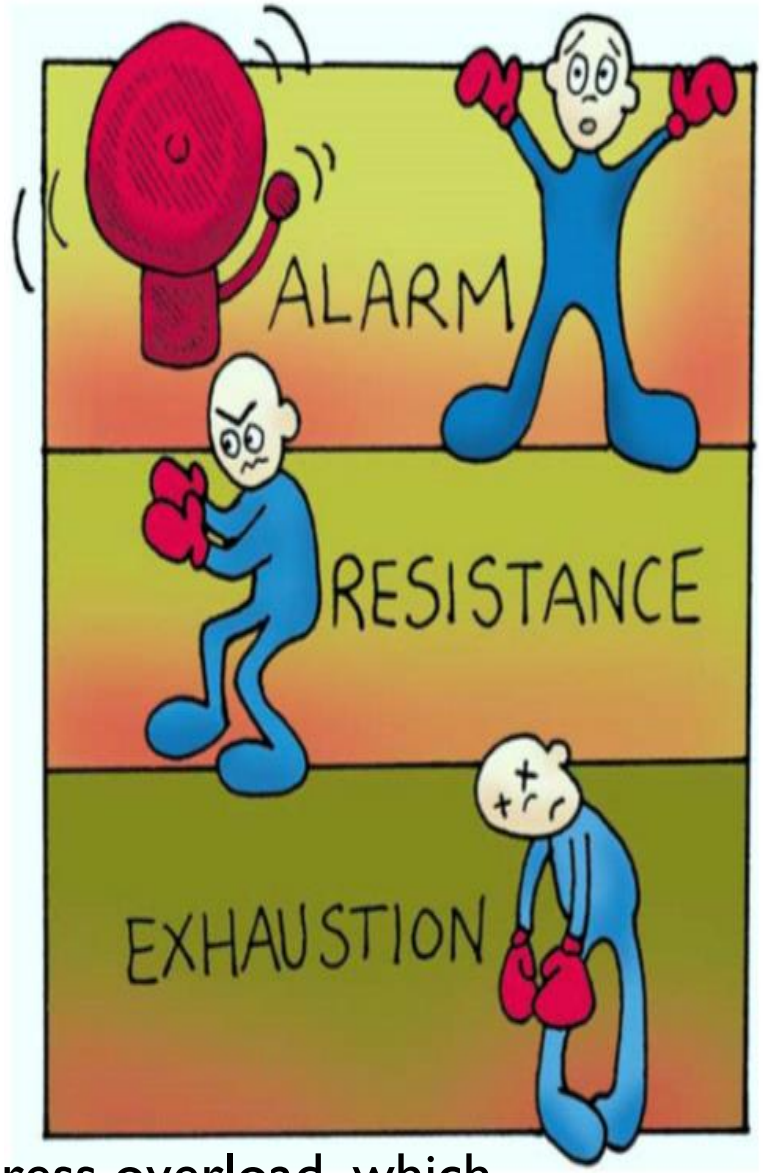
- This mechanism is an archaic signal that our life is endangered. So we have to use adequate adaptive response

A 3-stage biological response

Alarm Reaction. Initial reaction of the body when a threat to balance is identified. Immediately activates the fight or flight response system, and releases the "stress" hormones (*adrenaline, noradrenaline and cortisol*).

Stage of resistance. The body seems to adapt to the presence of the stressor (*endorphine)*

Stage of exhaustion. If the stress persists for a longer period, the body starts to lose its ability to fight the stressors and reduce their harmful impact because the adaptive energy is all drained out.



The exhaustion stage is the gate towards burnout or stress overload, which can lead to health problems if not resolved

The three automatic anwsers to survive

Fight

Fly

Freeze

- These reactions (**acute stress**) are very adapted to the wild life, faced to very threatful environment
- They are **less** adapted to the modern world in which they often have to be **inhibited**
- This inibition may produce **negative consequences** on the long term (**chronic stress)**

Biology of stress- video

Stressors are numerous & cumulative…

Professional stressors

- **Demand:**
  - Number of aircraft under control
  - Peaks of traffic load
  - Extraneous traffic
  - Unforeseeable events
- **Operating procedures**
  - Time pressure
  - Having to bend the rules
  - Feeling of loss of control
  - Fear of consequence of errors
- **Working time**
  - Unbroken duty periods
  - Shift and night work
- **Working tools**
  - Limitation and reliability of equipment
  - VDT, R/T, and telephone quality
  - Equipment layout

- **Work environment**
  - Lighting, optical reflection
  - Noise/distracters
  - Microclimate
  - Bad posture
  - Time pressure
  - Rest and canteen facilities
- **Working organization**
  - Role ambiguity
  - Relation with supervisors and colleagues
  - Lack of control over the work process
  - Salary
  - Public opinion

Occupational Stress and stress prevention in ATC, G. Costa 1996

Stressors: individual sensitivity…

Psychological approach of stress

- In psychology, stress is the not the situation but the physical of psychological reaction to a specific situation
- Stressor : stressful situation or a situation requiring adaptation

Type A and B personality

Type A

- Competitiveness, self critical
- Feel impatient
- Strive to think or do two or more things at once
- Cannot cope with leisure time
- A obsessed by numbers, measuring their success in terms or how much of everything they acquire

- Type B

- Never suffer from a sense of time urgency or impatience
- Feel no need to display or discuss either their achievements
- Play for fun instead of exhibit their superiority at any cost
- Can relax without guilt

Locus of control

Internal locus of control

- Believe that events in their life occur primarily from their own actions
- More likely to take responsability for their actions
- Tend to have a better health

• External locus of control

- Believe that events occur primarily from external factors
- Tend to blame others
- More frequent feeling of hopeless

Lazarus (1968) – Psychological Appraisal

Situation

Re-evaluation

Primary appraisal

Is this a threat ? A challenge ?

Perceived threat

No perceived threat

Secondary appraisal

What control do I have ?

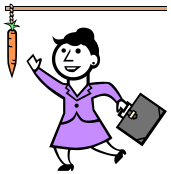
No coping

Coping

No stress

Stress

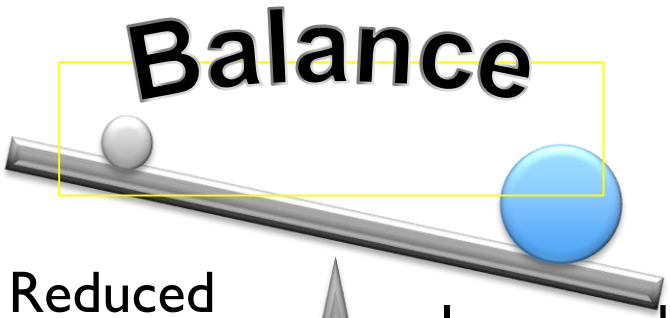
Stimulation



Lazarus, S. Folkman in Stress, Apraisal and coping, New-York, Springer, 1984

Positive balance
BETWEEN demands and resources

This cognitive model of stress shows ways to improve coping capacities



Reduced Perceived demands

Improved Perceived resources

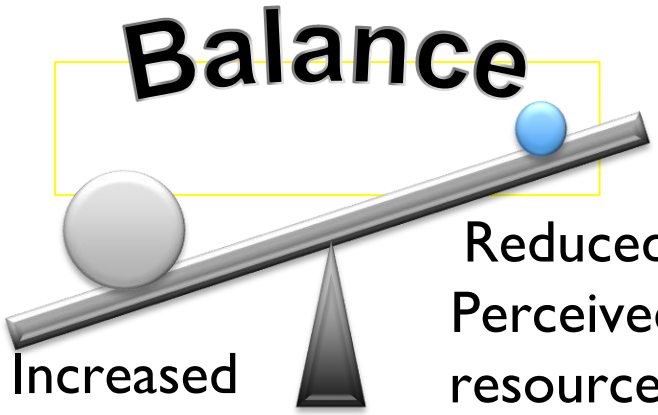
What is improving perceived resources is also reducing perceived demands:

Coping

- Training
- Familiarity
- Anticipation
- Strategies
- Self-confidence
- Motivation

Negative balance
BETWEEN demands and resources

This cognitive model of stress also explains adaptation failure: stress



Increased Perceived demands

Reduced Perceived resources

What is reducing perceived resources is also reinforcing perceived demands:

- Novelty
- Unfamiliarity
- Surprise
- Fatigue
- Lack of anticipation and strategies

Stress

The coping strategies

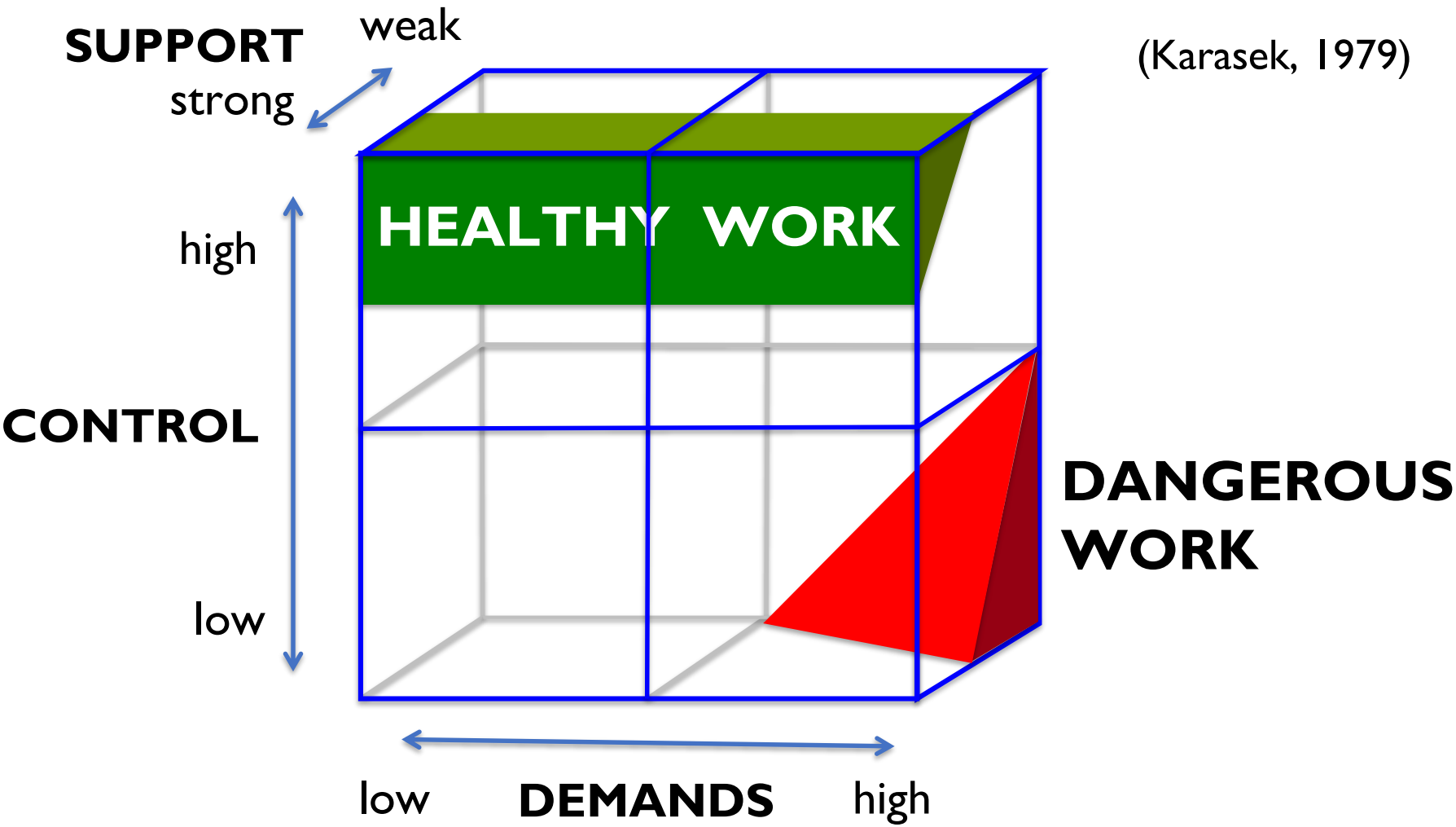
Problem focused coping

- Seeking social support (discussing problems with others)
- Taking control
- Evaluation the pros and cons
- Supressing competing activites
- Anticipatory coping

- **Emotion focused : when feel nothing that can be done about the problem**
- Denial
- Distancing
- Reappraisal : taking another look at the situation
- Arousal reduction

Males more likely to use Problem-focused methods, whereas women use emotion- focused

JOB DEMAND-CONTROL MODEL



(Karasek, 1979)

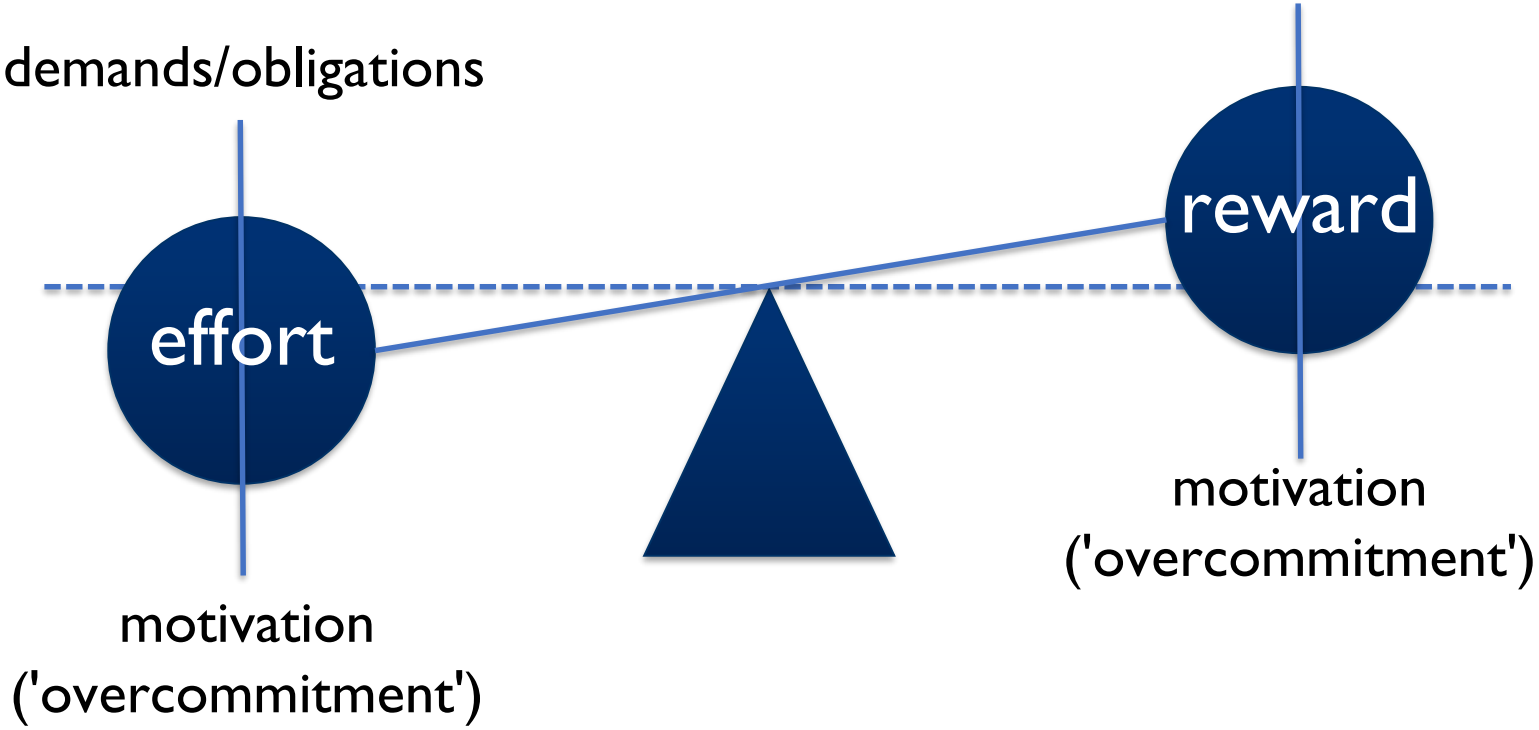
Predictive of health issues associated with stress

Job demand control

What about you ?

EFFORT-REWARD IMBALANCE
ERI MODEL (SIEGRIEST)

- Wage, salary
- Esteem
- Promotion / security



Imbalance maintained

- If no alternative choice available
- If accepted for strategic reasons
- If motivational pattern present (overcommitment)

PSYCHOSOCIAL FACTORS

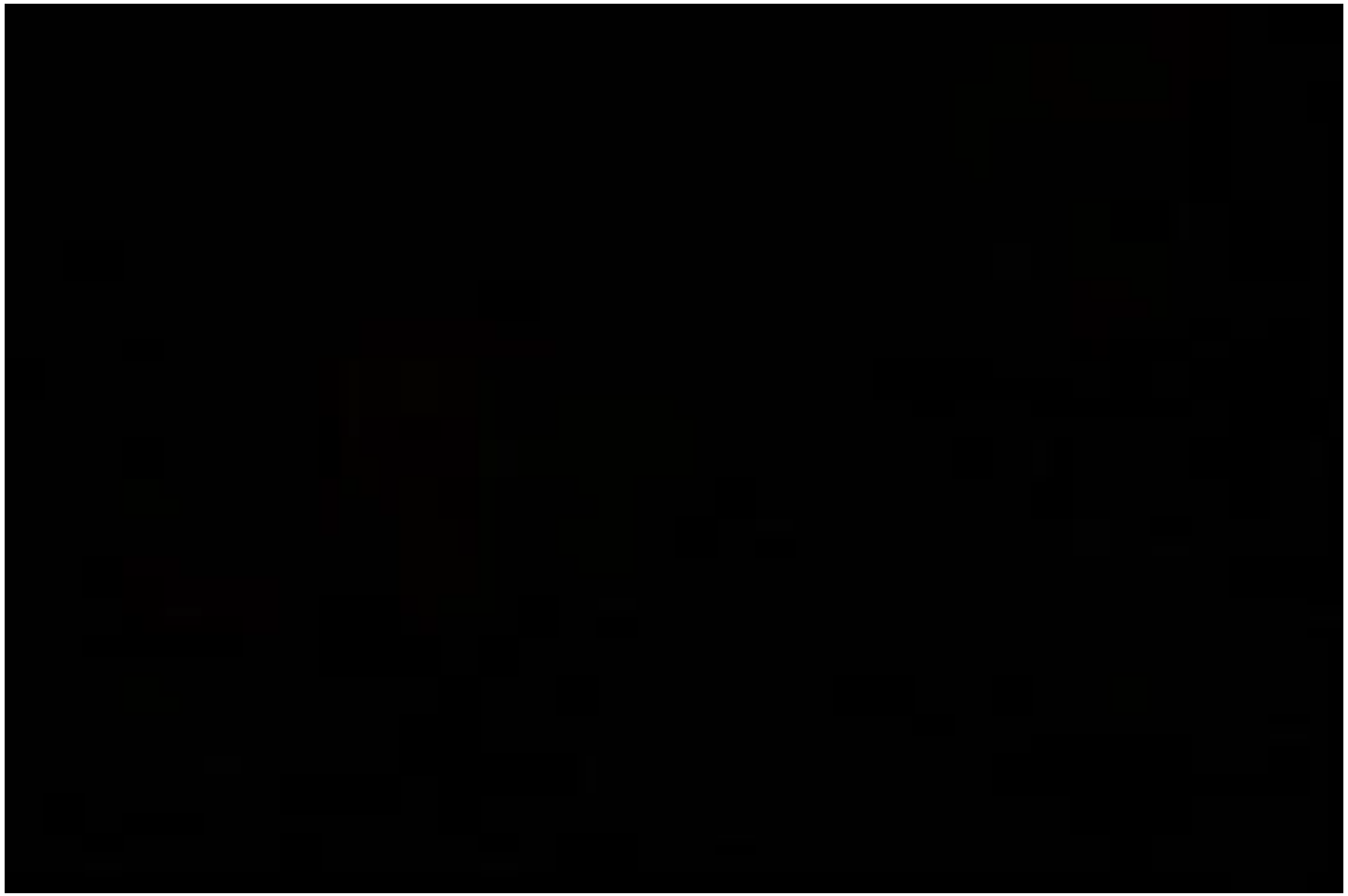
DEFINITIONS AND SCOPE OF SOCIAL PSYCHOLOGY

- Social psychology is about understanding individual behavior in a social context
- Deals with the factors that lead us to behave in a given way in the presence of others, and look at the conditions under which certain behavior/actions and feelings occur
- Topics examined in social psychology include: social cognition, social influence, attitudes and stereotypes

MILGRAM EXPERIMENT ON OBEDIENCE

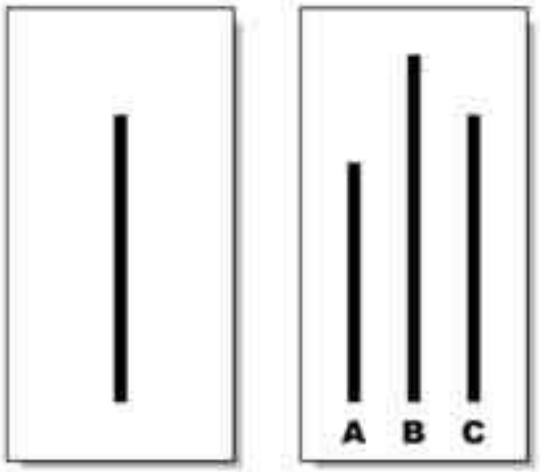
- Milgram (1963) investigates the obedience to authority
- Participants selected for his experiment by newspaper advertising for male participants to take part in a study of learning at Yale University
- Procedure : the participant (the teacher) was paired with another person (the learner, a colleague of Millgram)

MILGRAM EXPERIMENT-VIDEO



CONFORMITY EXPERIMENT-VIDEO

SOLOMON ASCH – CONFORMITY EXPERIMENT



- 8 participants and only 1 naïve subject
- Asked to compare the lines in a “vision test”
- The 7 confederates agreed before the experiment to give the wrong answer in 12 trials
- 32% of participants conformed with the incorrect responses
- 2 mechanisms :
  - normative influence: to fit in with the group
  - informational influence: they believe the group is better informed than they are

FACTORS AFFECTING CONFORMITY

Increase conformity

- Size of the group
- Task difficulty
- Status of Majority Group

Decrease conformity

- Social support (if one person gave a different answer, conformity dropped)
- Answer in private

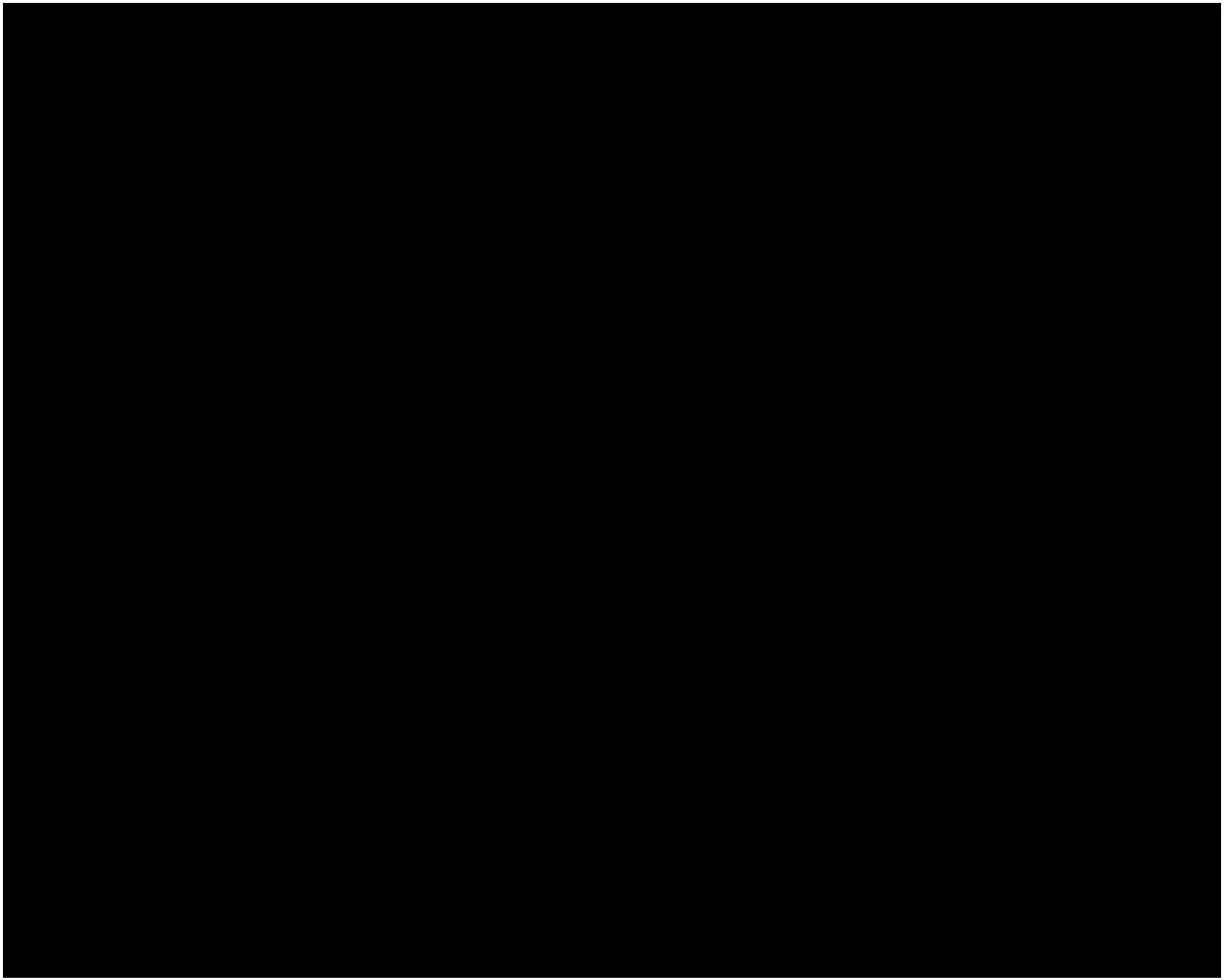
ATTRIBUTION THEORY

- When we explain the behavior of others we look for enduring **internal attributions**, such as personality traits: fundamental attribution error.

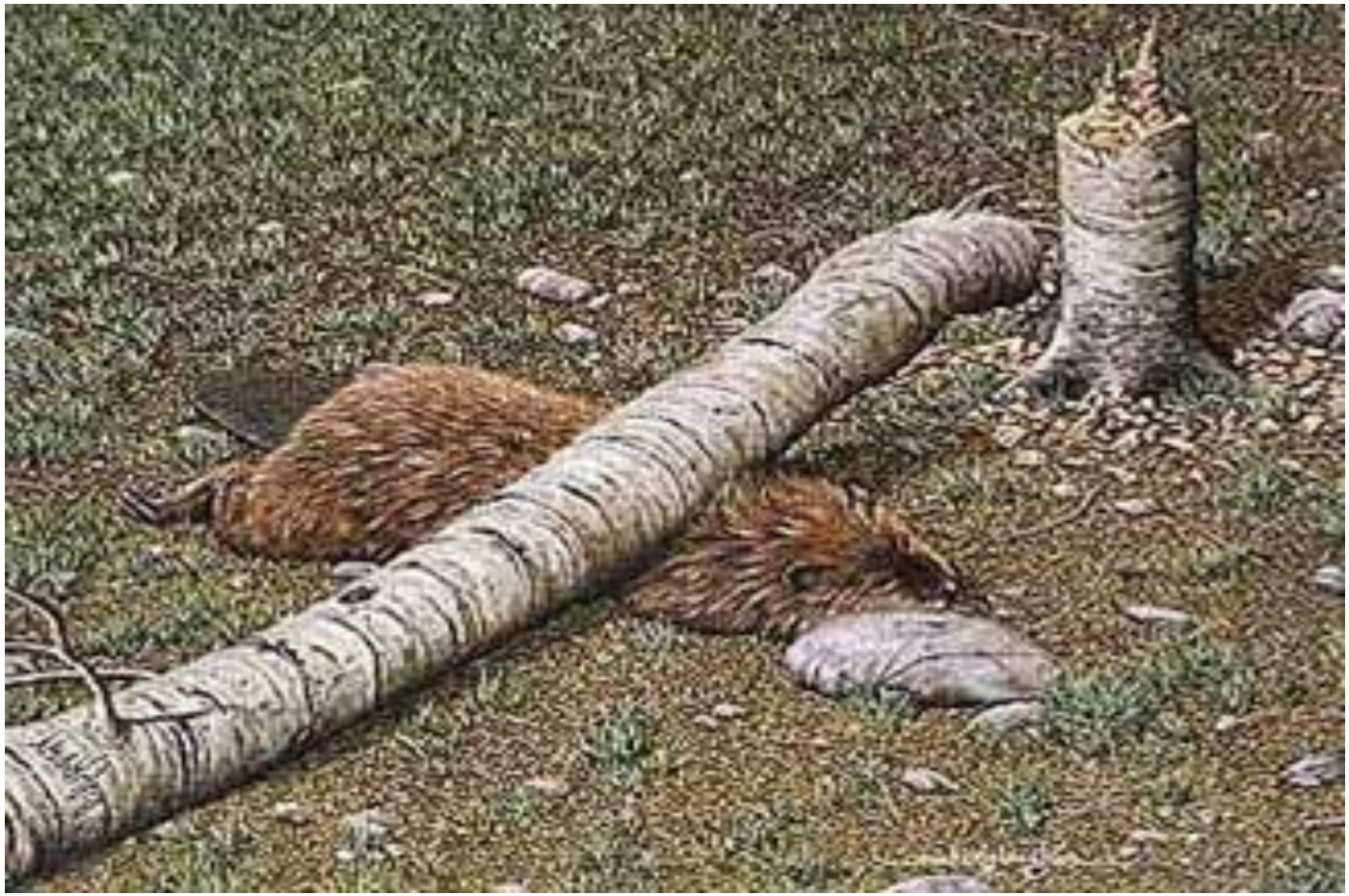
- When we try to explain our own behavior we tend to make **external attributions**, such as situational or environment.

HUMAN ERRORS & VIOLATIONS

MOVIE: BRITISH MIDLAND ACCIDENT



EVEN BEST EXPERTS CAN FAIL…



DIFFERENCE BETWEEN ERROR AND VIOLATION…

I am doing an error when...

- My intention is not adapted to the situation
- My action is not adapted to my intention

I am doing a violation when…

- I am not complying with a rule, a procedure a standard

By definition, there is no intention in error

- We can't decide to not committing error

Violation is a voluntary act

- Most frequent reason: « do the job»

WHY ARE THEY DOING THAT?

They are mad?

They are running out of time?

System failure?

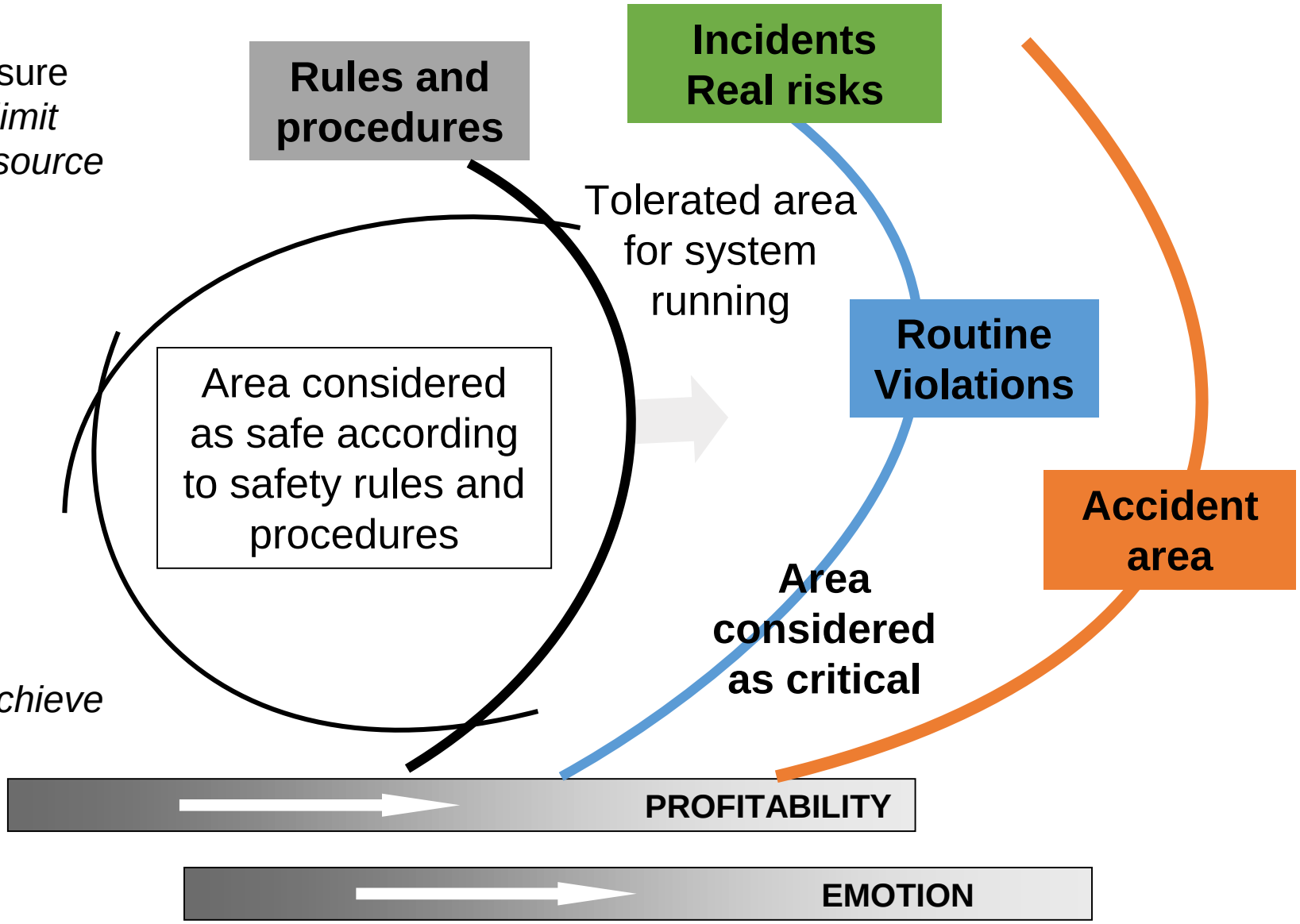
The willingness to do the job…

ADAPTATION AND PROGRESSIVE MIGRATION

Individual pressure
Quality of life, limit exploration, resource management

Technological pressure
Farther, faster, longer

Organisational pressure
Increased performance
Obligation to achieve

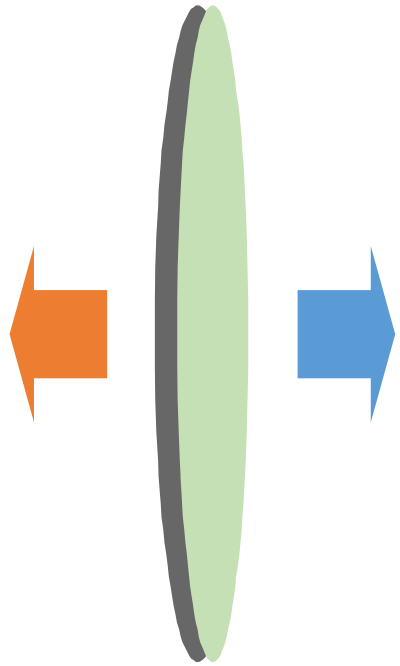


« ERROR IS HUMAN! »

« Errors and intelligence are the 2 sides of the same coin » (J. Reason)

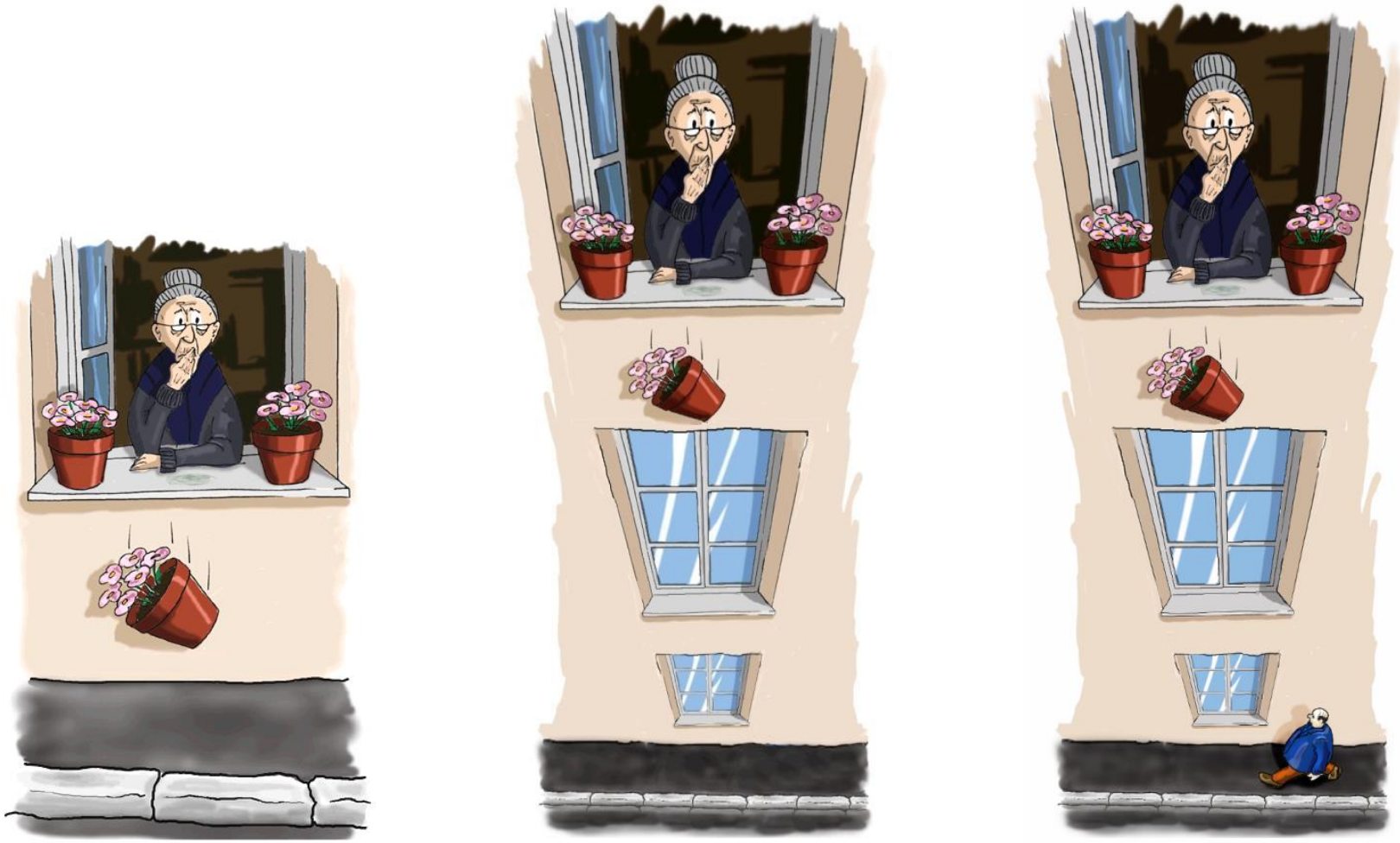
It means:

(1) : Everybody do error

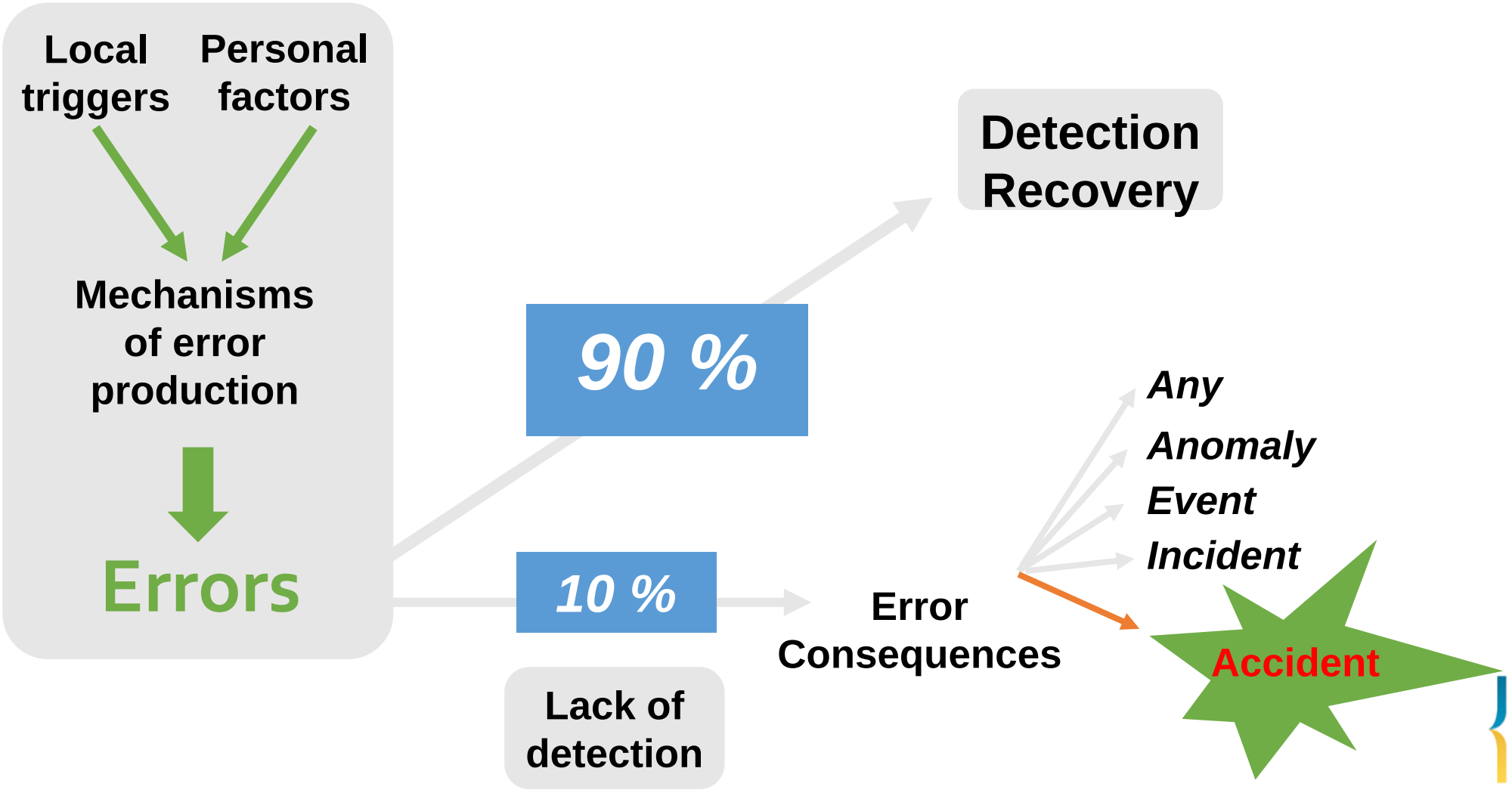


(2) : We use error to adjust our performance

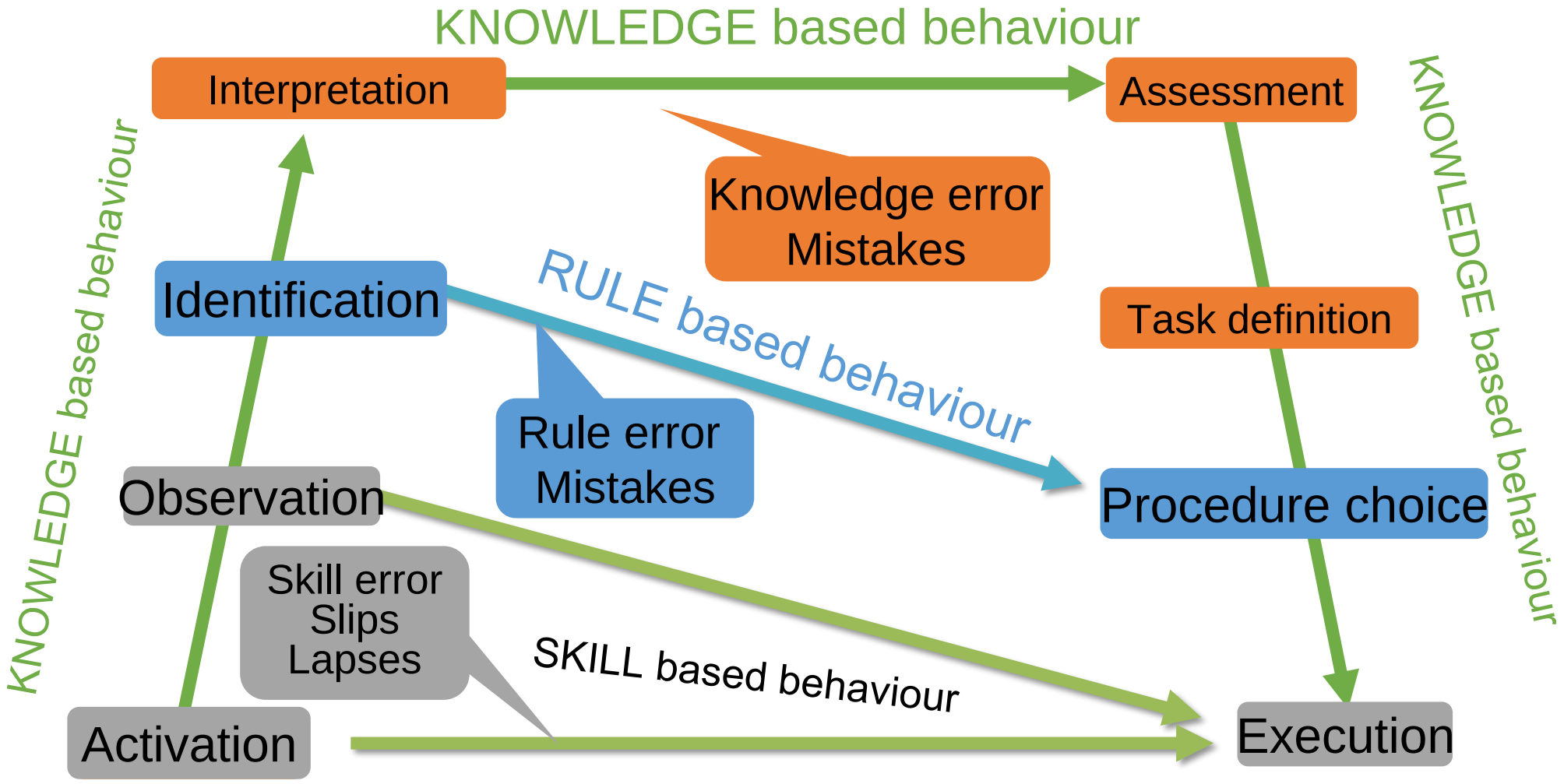
THERE IS NO LINK BETWEEN ERROR AND THEIR CONSEQUENCE



ERROR DETECTION AND RECOVERY



ACTIVITY CONTROL: SRK MODEL (RASMUSSEN)



Step ladder - Jens Rasmussen (1988)

« ERROR IS HUMAN? »

red green blue orange green orange red
blue orange red orange green orange blue
blue red blue red blue green orange blue red
orange green blue orange blue blue orange
green orange green blue red red orange
green blue green orange red rouge orange
green bleu blue red green blue red blue
orange green red green blue orange blue
red orange green orange blue blue

ERRORS AND LEARNING

When errors are detected

They are corrected

The behavior is adjusted:

- Increase of margin
- Increase of attention

red green blue orange
green orange red blue
orange red orange
green orange blue
blue red blue red blue

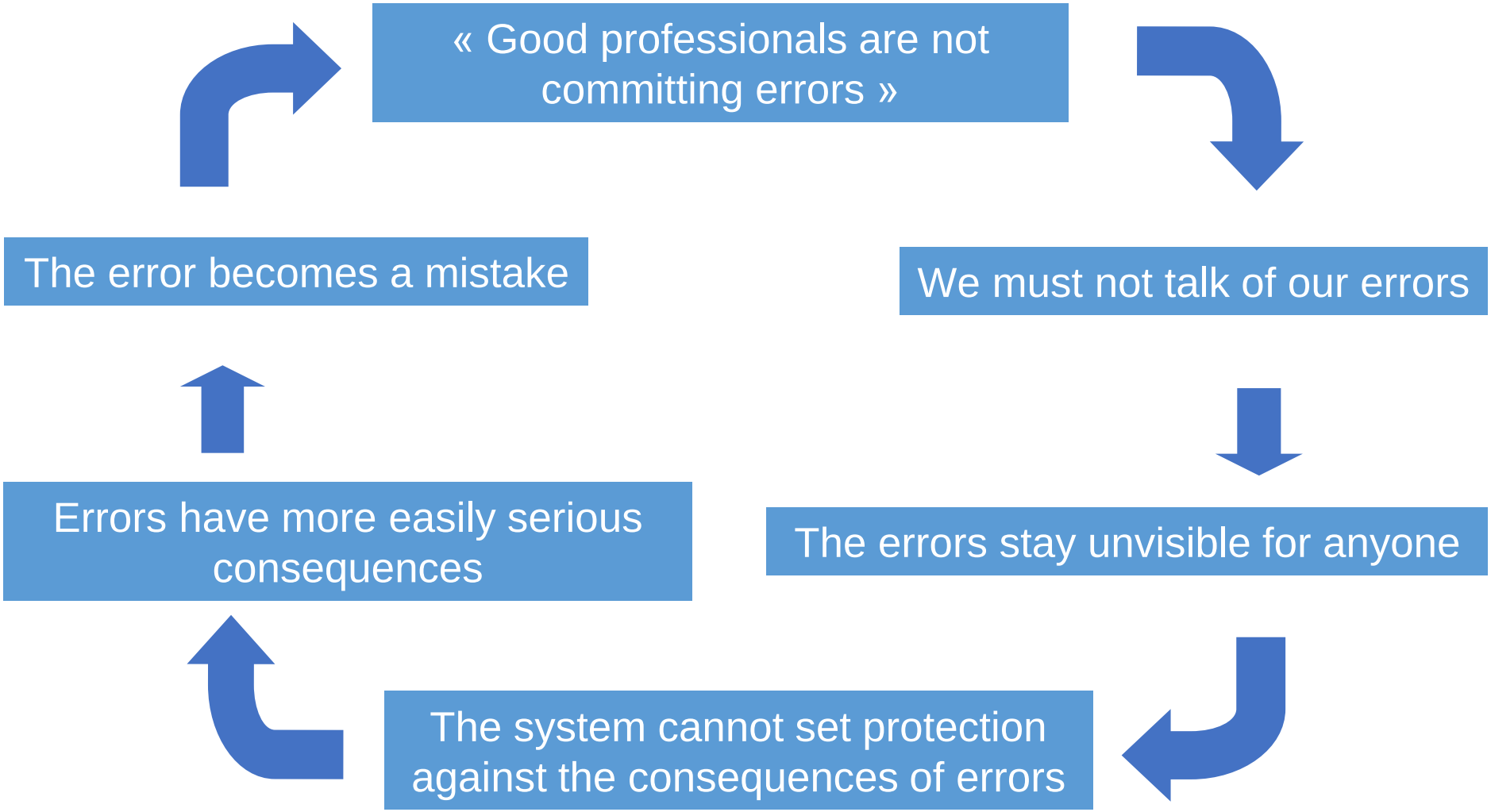
Short term improvement (adaptation)
Long term improvement (learning)

THE NEW CHALLENGE: MANAGE THE CONSEQUENCES

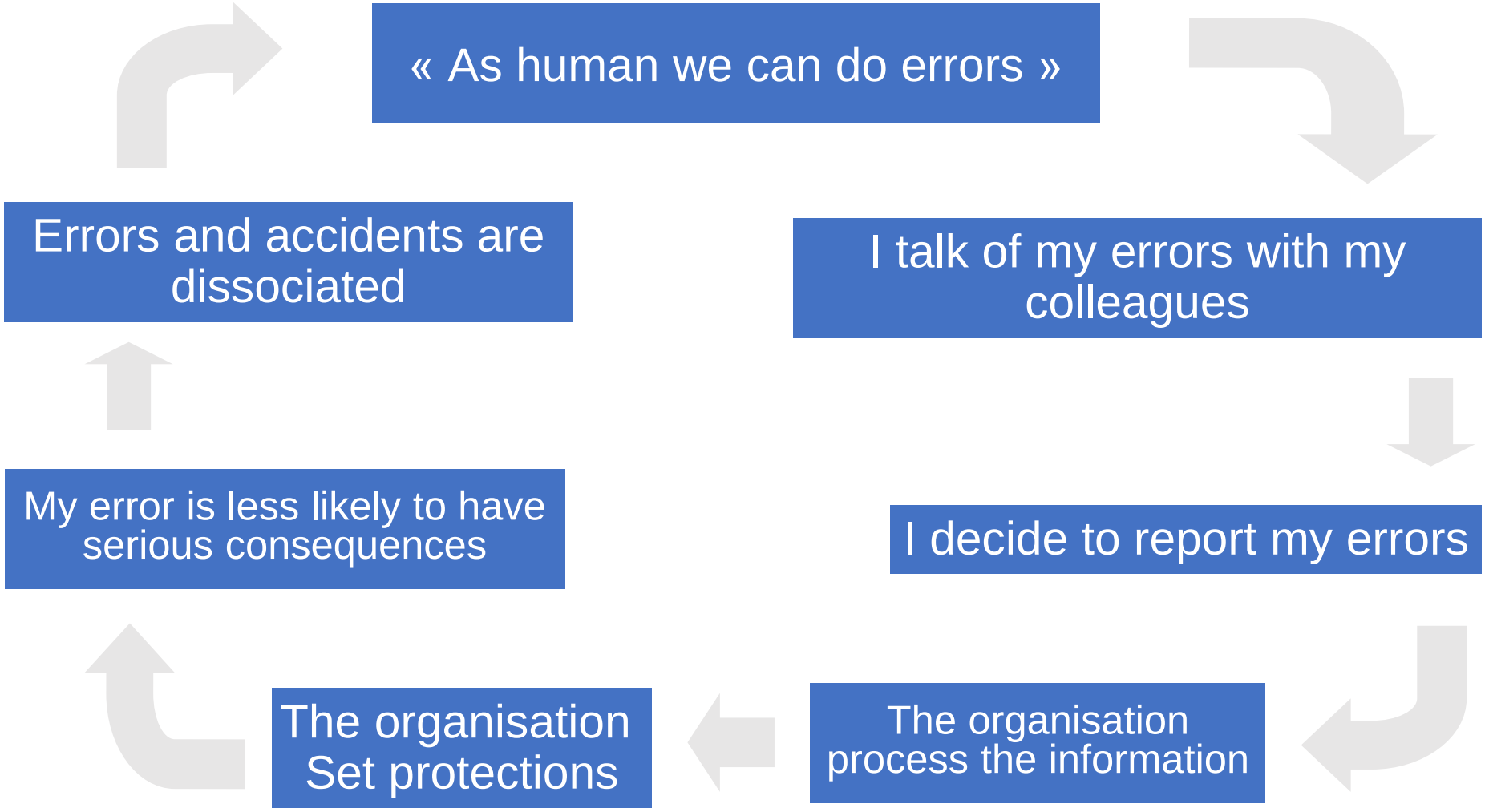
- Error is natural and cannot be avoided
- No link between error and their consequences
- What is needed is to manage the consequences

Managing the consequences is a very important aspect for a good professional

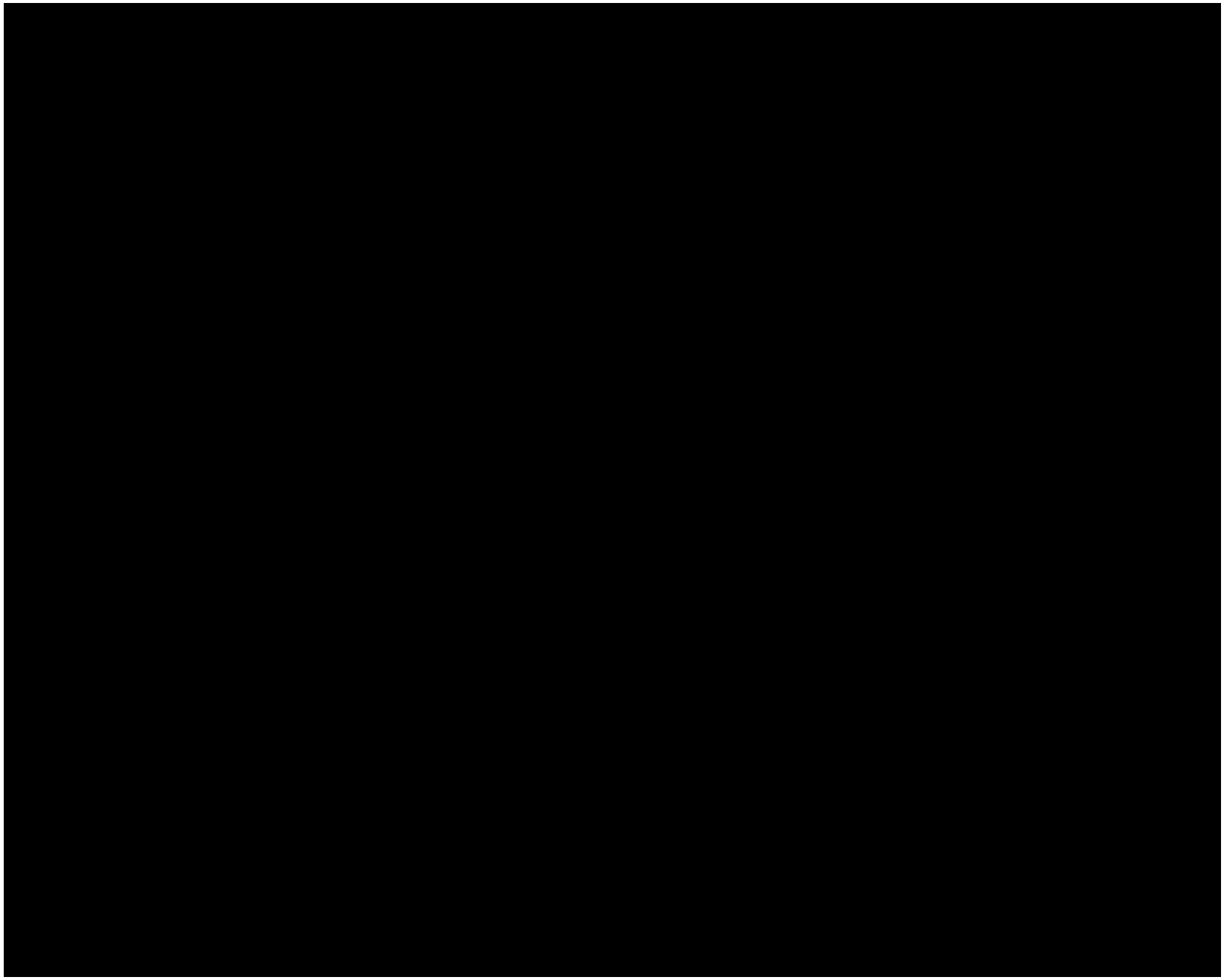
THE VICIOUS CIRCLE OF THE ERROR TABOO



THE VIRTUOUS CIRCLE OF HUMAN FACTORS

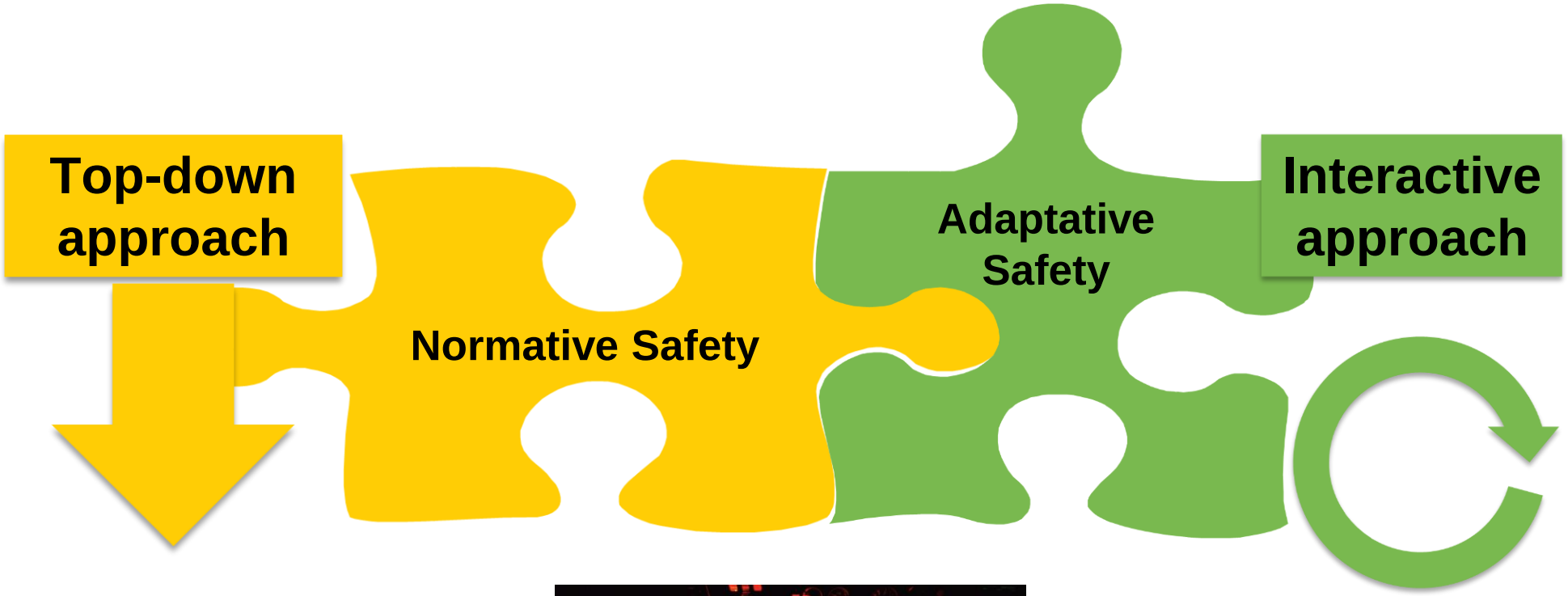


MOVIE: HUMAN ERROR IN MAINTENANCE



NORMATIVE VERSUS ADAPTATIVE SAFETY

Welbees



Compliance
- Rules
- Procedures
- Process

Resilience
- Flexibility
- Adaptation
- Skills

THE POSITIVE APPROACH OF HUMAN FACTORS

- Most of our understanding of safety is based on error, failures analysis
- We learn from our errors but even more from how we are able to manage our errors or critical situations
- Safety should learn from critical situations successfully managed (positive taxonomy)

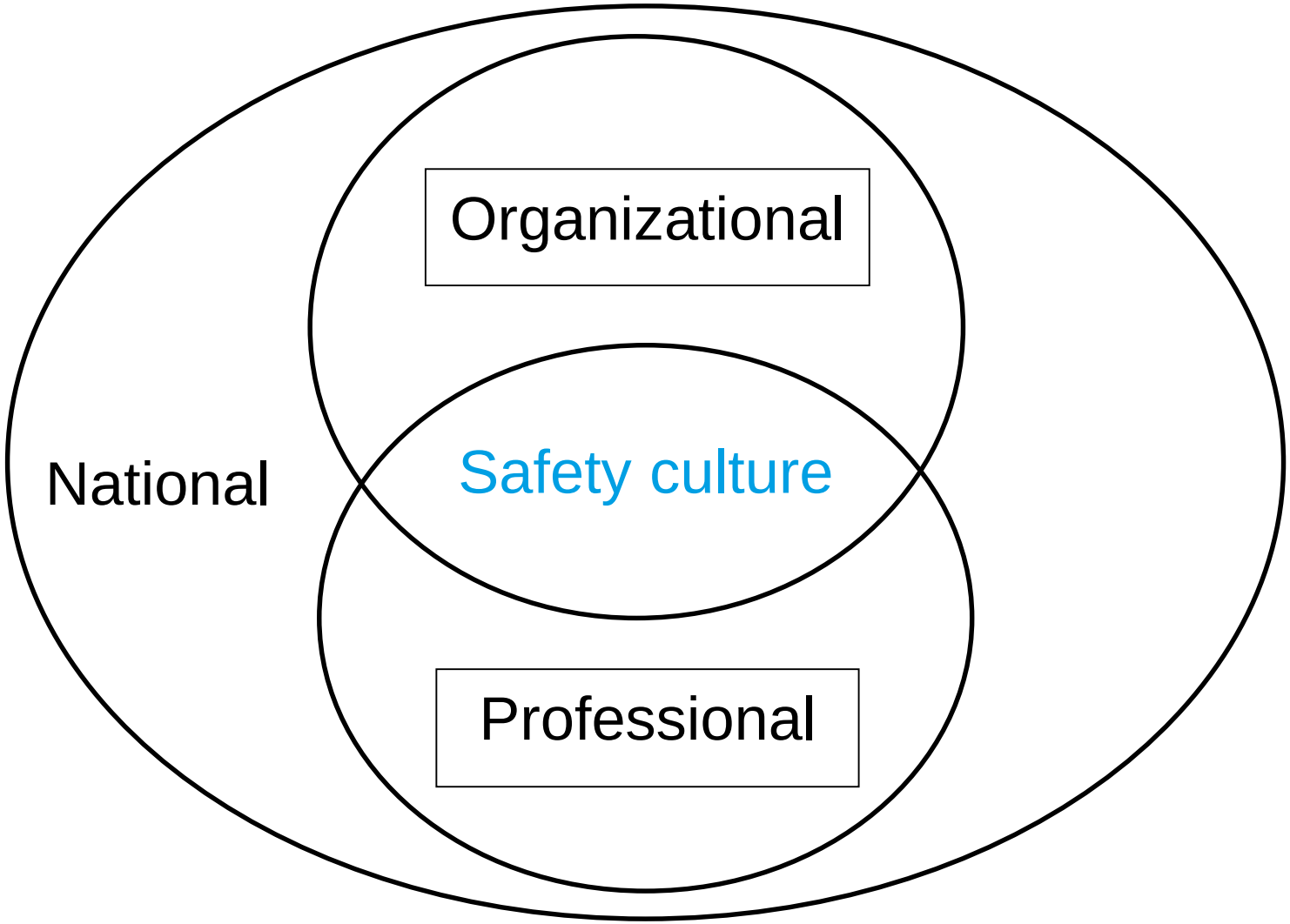
SAFETY CULTURE

SAFETY CULTURE DEFINITIONS

Safety Culture is the set of enduring values and attitudes regarding safety, **shared by every member** of every level of an organization

A culture in which front line operators **are not punished** for actions, omissions or decisions taken by them, that are commensurate with their experience and training, but in which gross negligence, willful violations and destructive acts **are not tolerated**

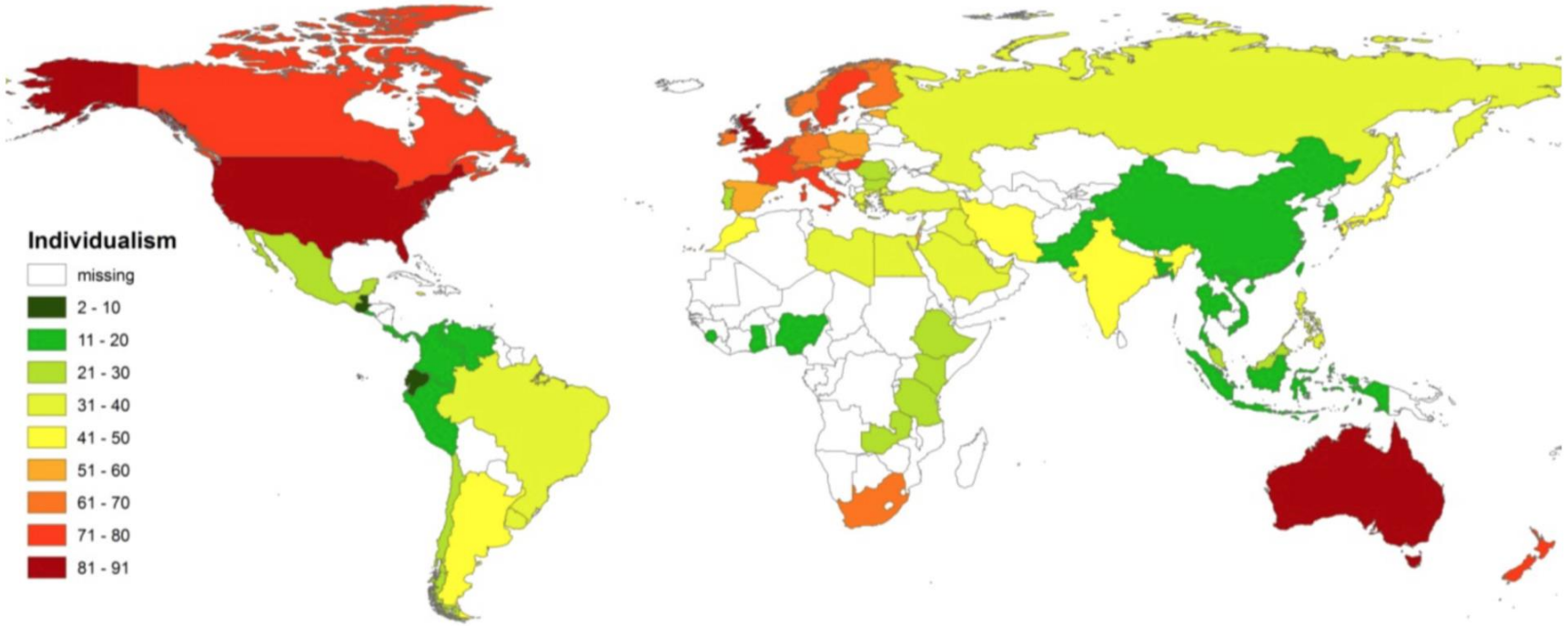
SAFETY CULTURE



SOME ASPECTS OF NATIONAL CULTURE

Individualism	Collectivism
value ***in***dependence	value ***inter****dependence*
promote personal ideals, strengths, and goals	promote group and societal goals and duties,
pursued in competition with others	blending in with group identity,
leading to individual achievement and finding	achievement attributed to mutual support

MEASURE OF INDIVIDUALISM

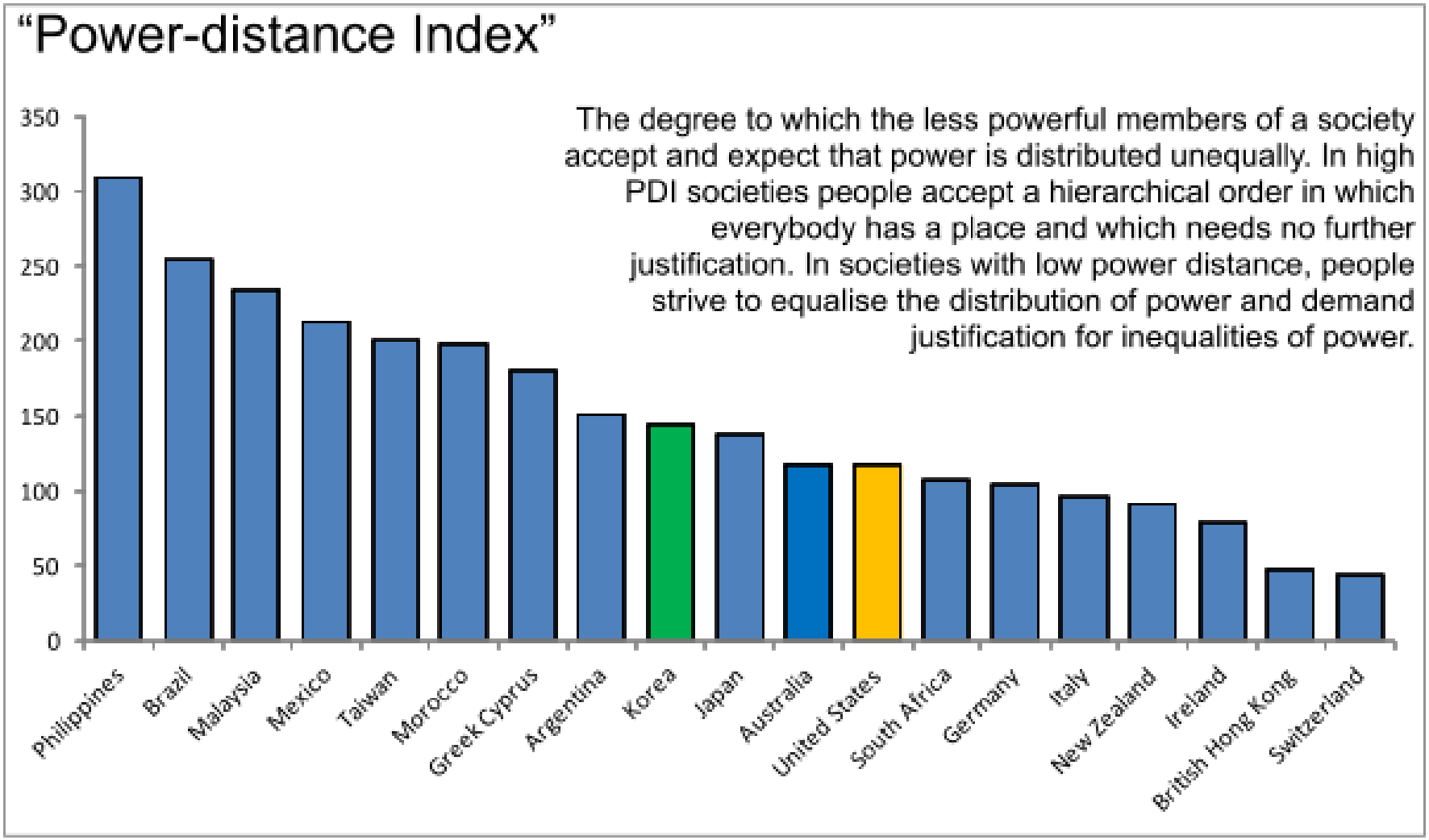


« THIS WAS A DISASTER ‘MADE IN JAPAN’ »

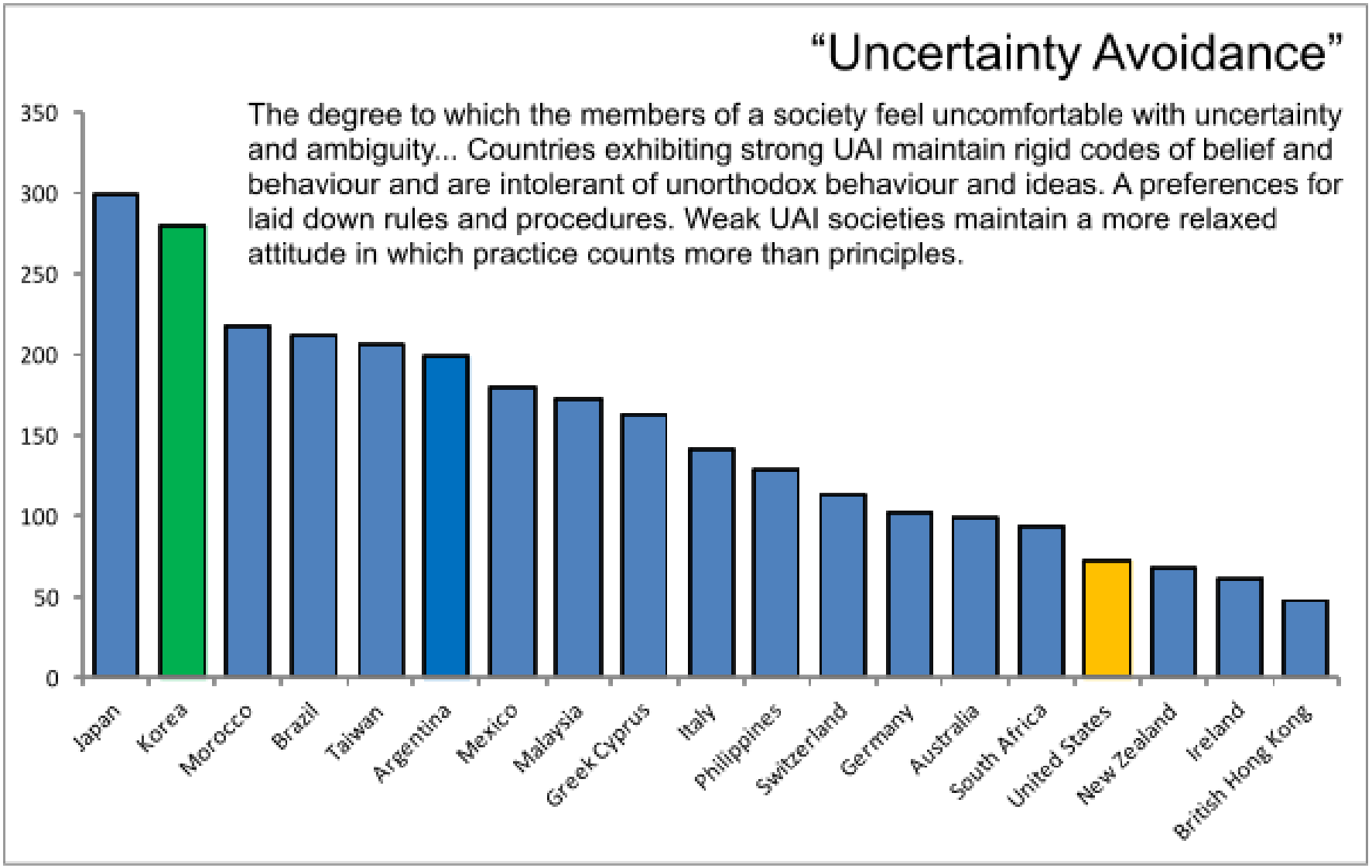
Fukushima Nuclear Accident Independent Investigation Commission

« Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity. »

POWER DISTANCE INDEX



UNCERTAINTY AVOIDANCE



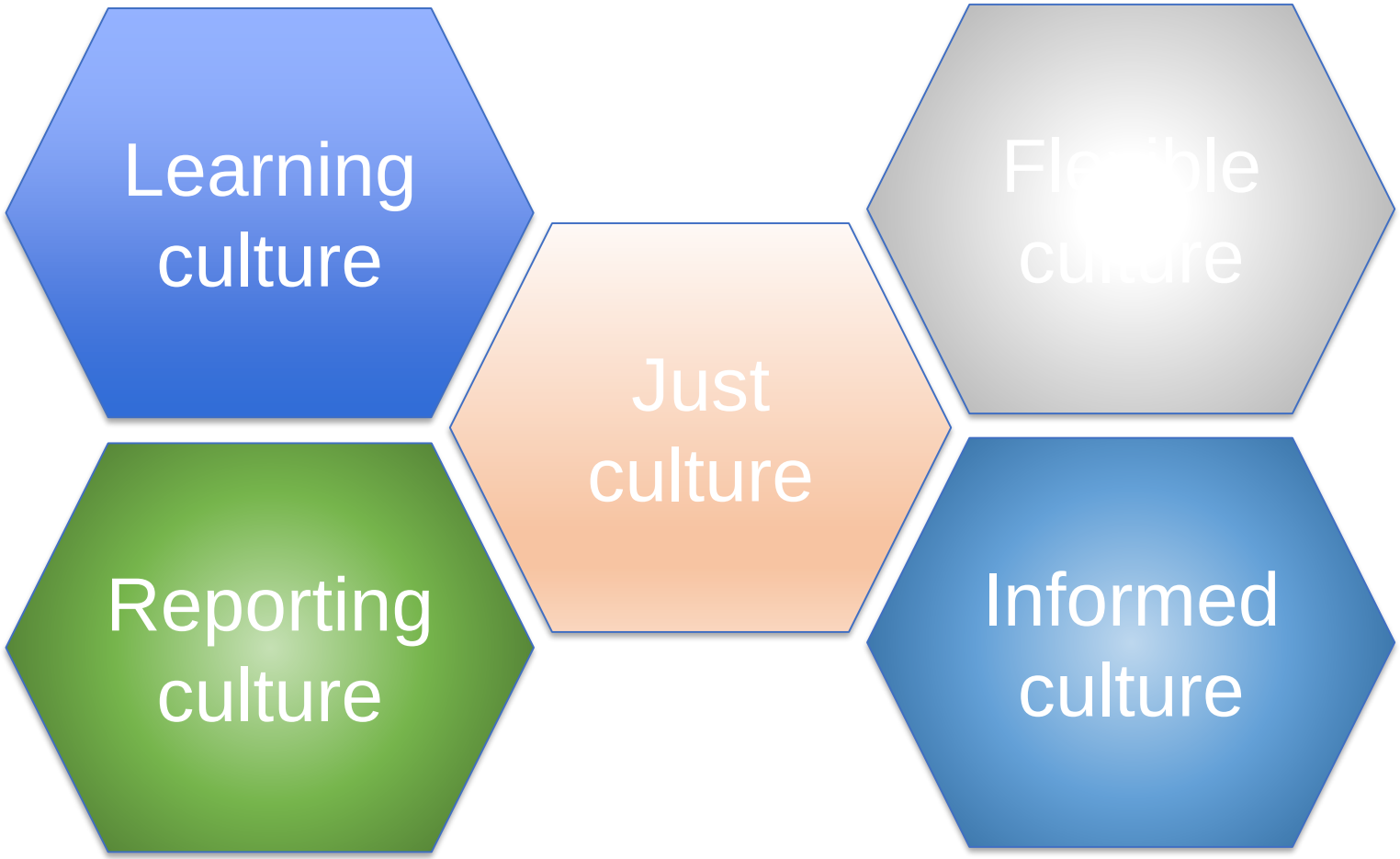
ORGANISATIONAL CULTURE (R. WESTRUM)

Pathological (power oriented)	Bureaucratic (rule oriented)	Generative (performance-oriented)
Low cooperation	Modest cooperation	High cooperation
Messengers shot	Messengers neglected	Messengers trained
Responsibilities shirked	Narrow responsibilities	Risks are shared
Bridging discouraged	Bridging tolerated	Bridging encouraged
Failures leads to scapegoating	Failures lead to justice	Failures leads to enquiry
Novelty crushed	Novelty leads to problem	Novelty implemented

Features of a positive safety culture

- Aware of the safety risks and known hazards induced by the operations;
- Continuously behaving to preserve and enhance safety;
- Willing and able to adapt when facing safety issues;
- Willing to communicate safety issues;
- Consistently evaluating safety related behaviours throughout the organization.

Safety culture features



Promoting a positive safety culture

Commitment to safety

- Management leads safety culture and is actively motivating employees
- Management provides resources for a range of safety related tasks

Adaptability

- Employee input is actively encouraged when adressing safety issues
- Organisational processess and procedures are questionned for their safety impact

Promoting a positive safety culture

Awareness

- Investigations seek to establish the root cause
- The organization systematically evaluates if safety improvements are implemented and working as intended

Behavior with respect to safety

- The working conditions support aviation safety at all times
- Continuous monitoring of safe behaviour is practised

Promoting a positive safety culture

Information

- Employees are provided with safety-relevant information in a timely manner in order to allow for safe operations or decisions to be made.
- Management and supervisors regularly check whether safety-relevant information is understood and acted upon

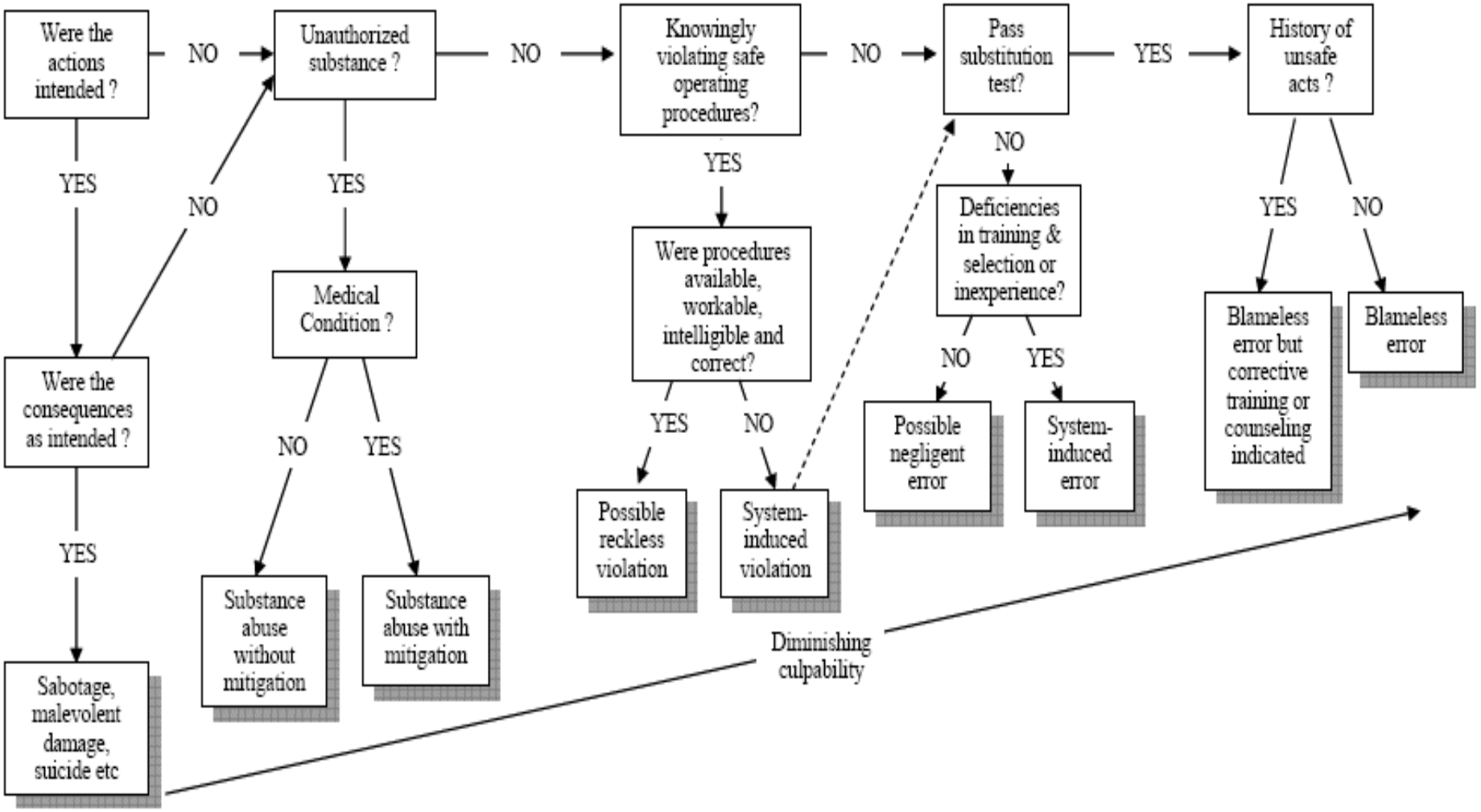
Trust

- There is a distinction between acceptable and unacceptable behaviour, which is known to all employees.
- Occurrences (including accidents and incidents) investigations consider individual as well as organizational factors.

JUST CULTURE - REASON (1987)

Malevolent damage Substance abuse for recreation	UNACCEPTABLE BEHAVIOUR
Substance abuse with mitigation Negligent error	"ACCEPTABLE BEHAVIOUR"
Unsafe acts	BLAMELESS BEHAVIOUR

SAFETY CULTURE DECISION TREE REASON (1997)



Practical exercice on safety culture

Objective

•to apply safety culture principles to concrete use cases of individu

Description

•Set-up 4 groups
•9 cases to be evaluated by each group
•Applying the safety culture decision tree
•Group presentations and discussion

Safety culture cases (1/6)

Case n° 1 - This is your captain speaking

The captain pressed the radio switch for the ATC instead of the cabin address system. The Air Traffic Controller was hearing the captain making a fairly standard speech to the passengers. After the announcement, the controller simply said: 'you are still on my frequency, sir". The captain did not respond. Probably he was wondering what he had done, realized it, corrected his error by pressing the right switch this time, and made his address to the passengers again.

Case n° 2 - Sleeping well

The captain thought he would sleep a little better with a drink, although there were less than 12 hours "from the bottle to the throttle".

Case n°3 – Going home

- One afternoon an alarm went of on an industrial site with multiple plants. It was unclear if this was an exercise or a real alarm. Also, it was not known from which of the plants the alarm had been triggered.

- As standard procedure dictates, people went inside the office buildings and sealed doors and windows. The emergency crew counted everybody and checked the safety of the location. The alarm persisted. At some point, one of the people got up, started packing his stuff and said he was going home "because this was an exercise anyway". He ignored repeated instructions from the emergency staff and left the building, walking across the site to go home.

Safety culture cases (3/6)

Case n° 4 – Low level fly-past

A senior pilot with Cathay Pacific Airways has been sacked for an "unauthorised low-level flypast" of a new Boeing 777-300ER in Seattle. The captain of this acceptance delivery flight was sacked for not obtaining the correct approval of the company to show off the new aircraft.

Safety culture cases (5/6)

Case n° 5 – New-born

Pilot has a very bad night (only 3 hours of sleep) because of his newborn cries. He has to fly the next day and decides to report for the duty after taking 3 cups of coffee.

Case n° 6 – Nah I will make it…

Although he could not see the runway yet, the captain descended the aircraft below the minimum descent altitude because he was low on fuel and did not want to go-around.

Safety culture cases (6/6)

Case n° 7 – Depressive pilot

A depressive pilot goes to see his doctor and receives a prescription of antidepressant without telling the doctor that he is a pilot. He does not informed the company while under meds.

Case n° 8 – Not taking notice of notices

A maintenance technician was coming in for his shift to begin. He was perhaps a trifle late, but hey, everybody is working overtime these days with the shortages. And anyway, he had one minute to spare. He passed the board with "important notices" but he was confident that since his last shift yesterday things could not possibly have changed.

Group exercice

Cases	Group 1	Group 2	Group 3	Group 4
1	X			
2	X			
3		X		
4		X		
5			X	
6			X	
7				X
8				X