Vietnam Airlines
REACH FURTHER

CHƯƠNG TRÌNH XÂY DỰNG VĂN HÓA AN TOÀN
QUẢN LÝ RỦI RO 2019

CREW RESOURCES MANAGEMENT (PILOT)

JUST CULTURE

ADVANCED DEVELOPMENT 2019

Ho Chi Minh City, December 26th-27th -28th, 2019

Welbees

PHILIPPE CABON PRESENTATION

- Master in Psychology and PhD in Neuroscience
- Associate Professor in Human Factors at University of Paris
- 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

- Day 1 : Introduction to human factors and CRM
  - History and definition of CRM
  - CRM and safety
  - Basic Human Performance Limitations
    - Perception
    - Cognition
    - Psychosocial factors
- Day 2 & 3 : CRM topics:
  - Communication
  - Leadership
  - Teamwork
  - Decision making
  - Situation awareness
  - Fatigue and stress

CONTENTS

- Introduction, context and definition
- Physiological factors :
  - In-flight incapacitation
  - Hypoxia
  - Perception and illusion
- Cognitive factors:
  - Memory :
  - Understanding
  - Decision making :
  - Situation awareness
  - Errors and errors management
- Fatigue and stress
  - Sleep regulation
  - The consequences of sleep deprivation
  - Fatigue self awareness
  - Fatigue management
- Psychosocial factors
  - Obedience
  - Conformity
  - Communication : à faire : trouver des jeux, tests + exemples d'accidents
  - Leadership
- Organisational factors & safety culture

DEFINITIONS

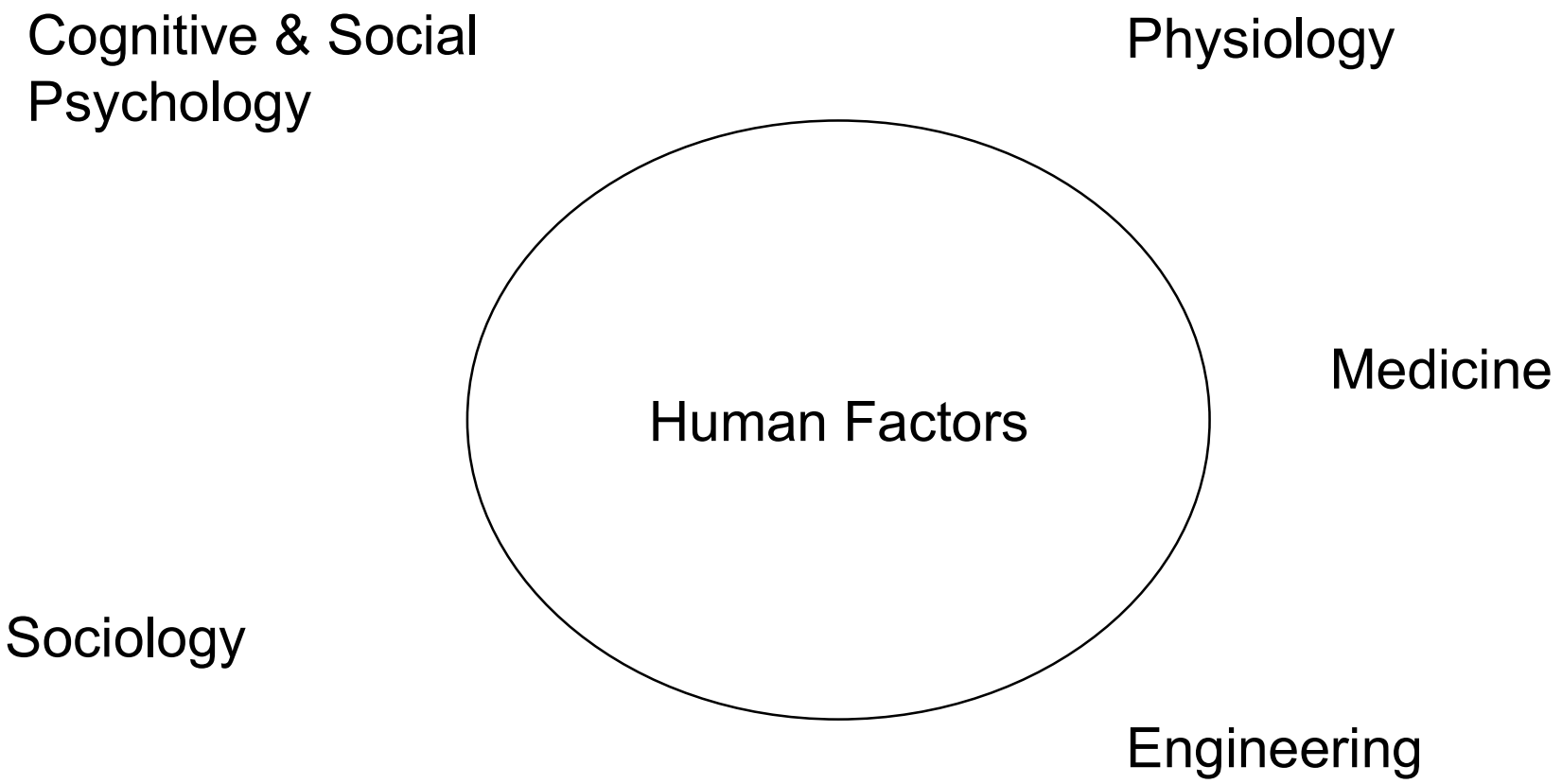
DEFINITION OF THE INTERNATIONAL ERGONOMICS ASSOCIATION

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 equipments**

SCOPE AND APPLICATIONS OF HUMAN FACTORS

THE APPLICATION OF HUMAN FACTORS IN AVIATION (1/4)

- 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 (2/4)

- 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 (3/4)

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

THE APPLICATION OF HUMAN FACTORS IN AVIATION (4/4)

- Air Traffic Control:
  - Team Resource Management
  - Standardised communication protocols,
  - Supervision to split the sector at high workload times,
  - Use effective visual scan techniques,

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 drip 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 strikeYou 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

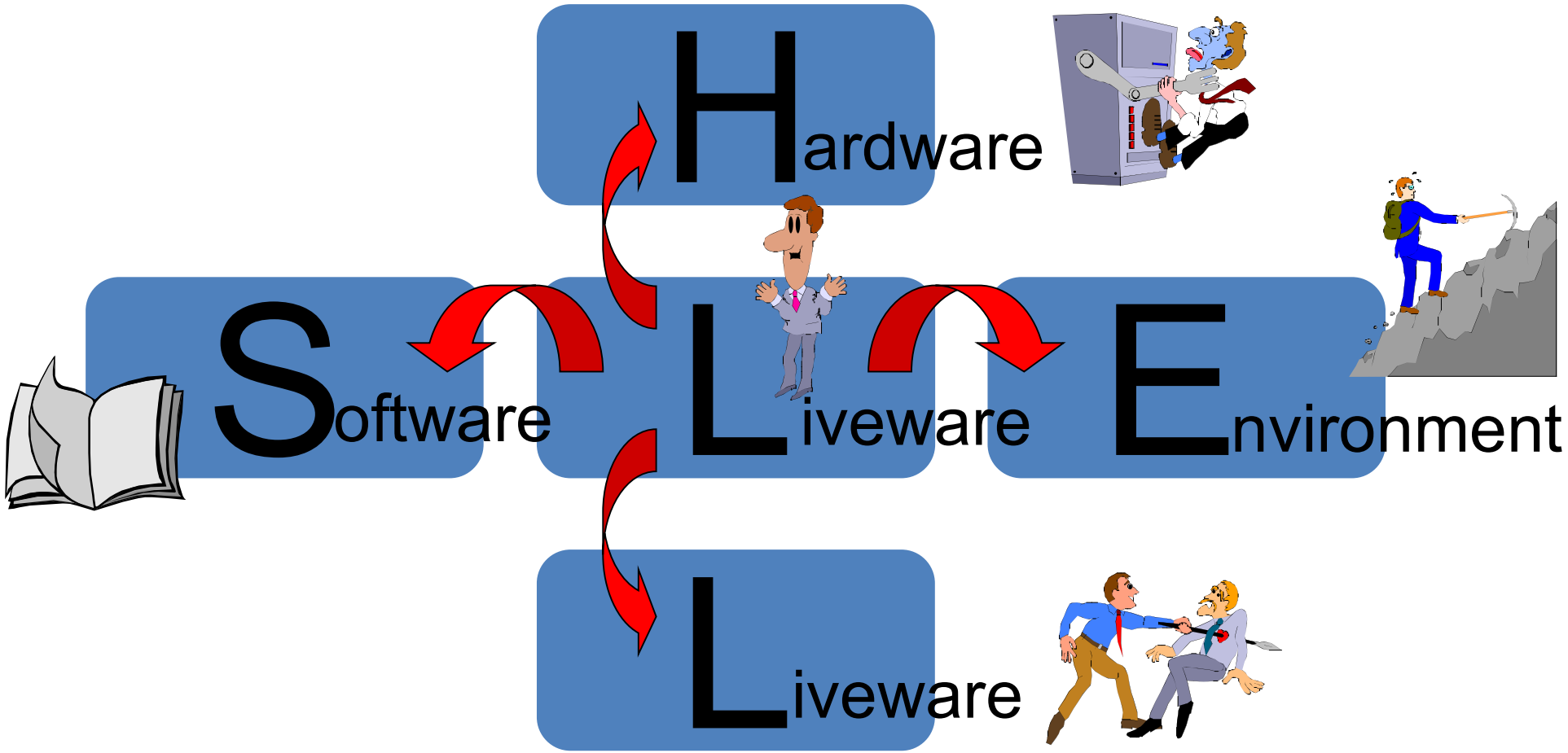
Organisation
Organizational culture, safety culture, just culture, training

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)



HISTORY AND DEFINITION OF CRM

HISTORICAL PERSPECTIVE

ICAO recommends HF training aviation professionals

ICAO recommends CRM for Pilots, Mechanics, maintenance and marketing

JAA & FAA adopts common HF rules for maintenance

Cockpit HF Certif A380 & A400M

1st CRM United

FAA recommends CRM

France adopts CRM & HF rules

JAA & FAA adopt common HF and CRM rules

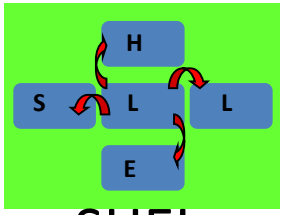
Tenerife

A320

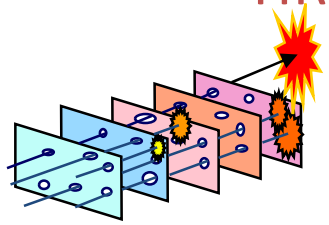
1985 **1990** **1995** **2000** **2005** **2009**

HRO 1994

Systemic models



SHEL Edwards 1972



Reason 1990

FAA & JAA recommend HF rules for design (traceability, error management, methods…)

THE FIVE GENERATIONS OF CRM TRAINING

- First generation (1981, United airlines). Focus on psychological testing and general concepts (eg leadership)
- Second generation: starts to deal with aviation concepts related to flight operations. Topics include team building, briefing strategies, situational awareness and stress management
- Third generation: greater emphasis on organizational culture and automation. Expand to other professionals (cabin crews, maintenance)
- Fourth generation: FAA implements the advanced qualification program in 1990, CRM integral part in flight training (eg LOFT)
- Fifth generation: errors in aviation cannot be fully eliminated, development of Threat and Error Management (TEM)

ACCIDENTS ATTRIBUTED TO INAPPROPRIATE CREW COOPERATION

- Everglades accident, 29 December 1972
- Tenerife accident, 27 March 1977
- Sioux City 19 July 1989,

GOALS OF CRM

- Knowledge
- Skills: **non technical** skills versus technical skills
- Attitude: **not personality**!

HUMAN PERFORMANCE LIMITATIONS

THE BASIC MEDICAL REQUIREMENTS FOR PILOTS (JAA CIVIL AVIATION MEDICINE, 2005)

- To be aware of our position in space – this requires an adequate sensory input, visual, auditory, proprioceptive etc.
- The mental capacity to process this sensory information and to initiate the appropriate action to control the aircraft safely.
- The necessary physical capacity to carry out the course of action decided upon.

CREW INCAPACITATION

- **Obvious incapacitation**: medical event that resulted, or would have had the propensity to result, in an inability to act as flight crew for at least 10 min

- **Subttle or partial incapacitation** associated with symptoms that resulted, or would have had the propensity to result, in a reduction of function or distraction from the flight crew task, but would be unlikely to have caused loss of control of an aircraft

- **Evans et al. (2012) : annual rate of incapacitation in UK (2004)**
  - 36 incapacitations (main causes: cardiovascular and neurological)
  - 20 impairments (main causes : cardiovascular and psychiatric)
  - Greatest risk factor : age (X 5 in 60's compared to 40's)

- **Subttle incapacitation are more difficult to detect and requires a good crew communication**

EFFECTS OF HYPOXIA

- Poor attention, memory and coordination functioning
- Voice changes
- Insidious behavioural changes, *eg: euphoria, loss of judgement, but subjectively, FEEL NORMAL!*
- Loss of consciousness,
  - With or without preliminary cognitive signs,
  - Possibility of a total amnesia
  - Erratic movements of arms and head

EFFECTS OF HYPOXIA

HELIOS ACCIDENT

AAIASB REPORT "DOOMED FROM THE OUTSET"

Before the flight, maintenance crew who had carried out a pressurisation check **left the control on manual** instead of automatic and the **pilots failed to correct this** during pre-take-off checks, so the aircraft did not pressurise as it climbed.

Post-take-off checks require no further confirmation of the pressurisation control selection.

When the audible cabin altitude alert sounded, the crew thought it was an **erroneous configuration warning because the sound is identical**, and their subsequent mindset and actions were determined by this preconception until **hypoxia overcame them as the aircraft continued to climb**.

When the decompression alarm went off, the crew – **who had assumed that the decompression switch was on auto** – mistakenly took this for **a glitch in the positioning of the flaps**, because the sounds emitted in both cases are identical.

As the aircraft climbed to 34,000 feet, both the **pilots and passengers gradually suffered the effects of hypoxia**, or low oxygen in the blood: giddiness, loss of consciousness and finally deep slumber.

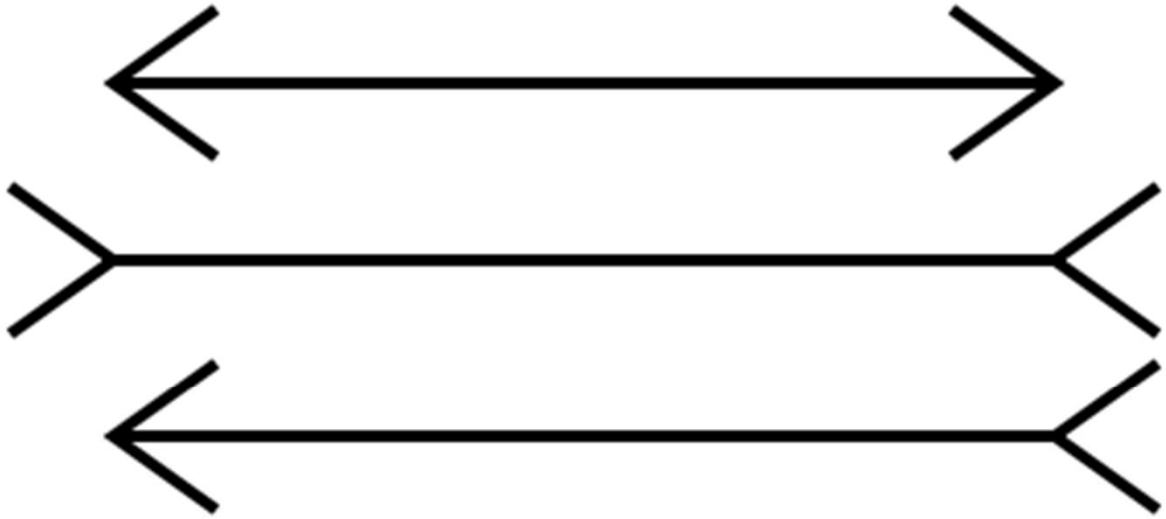
The Captain, who had left his seat to check the cooling system, is believed to have **fainted** inside the cabin.

PERCEPTION

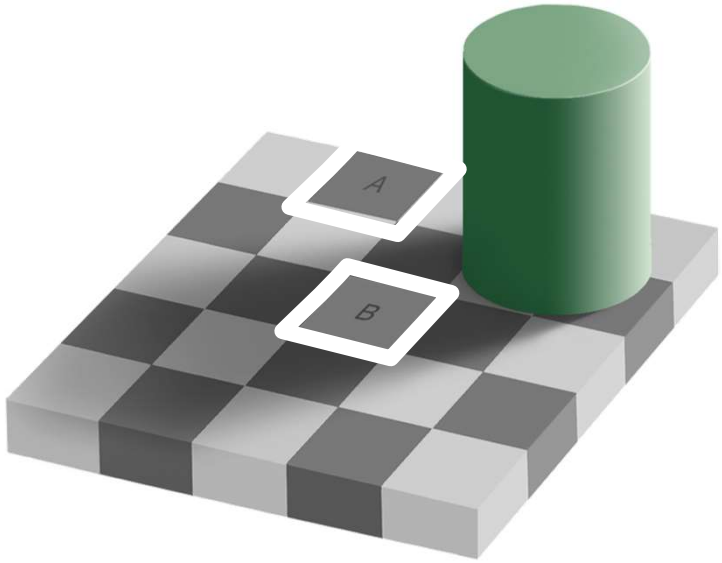
OUR PERCEPTION IS UNDER 3 CONSTRAINTS

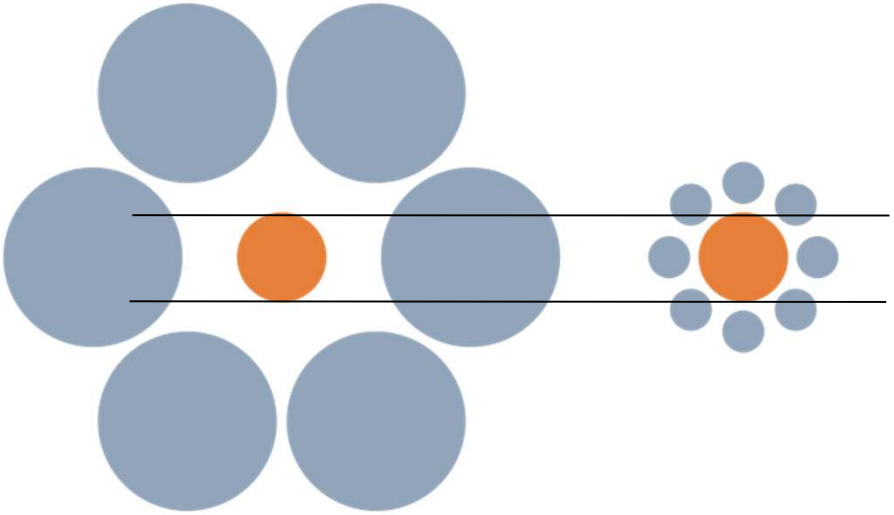
- We see what we can see
- We see what we want to see
- We see what we learnt to see

DEPTH PERCEPTION

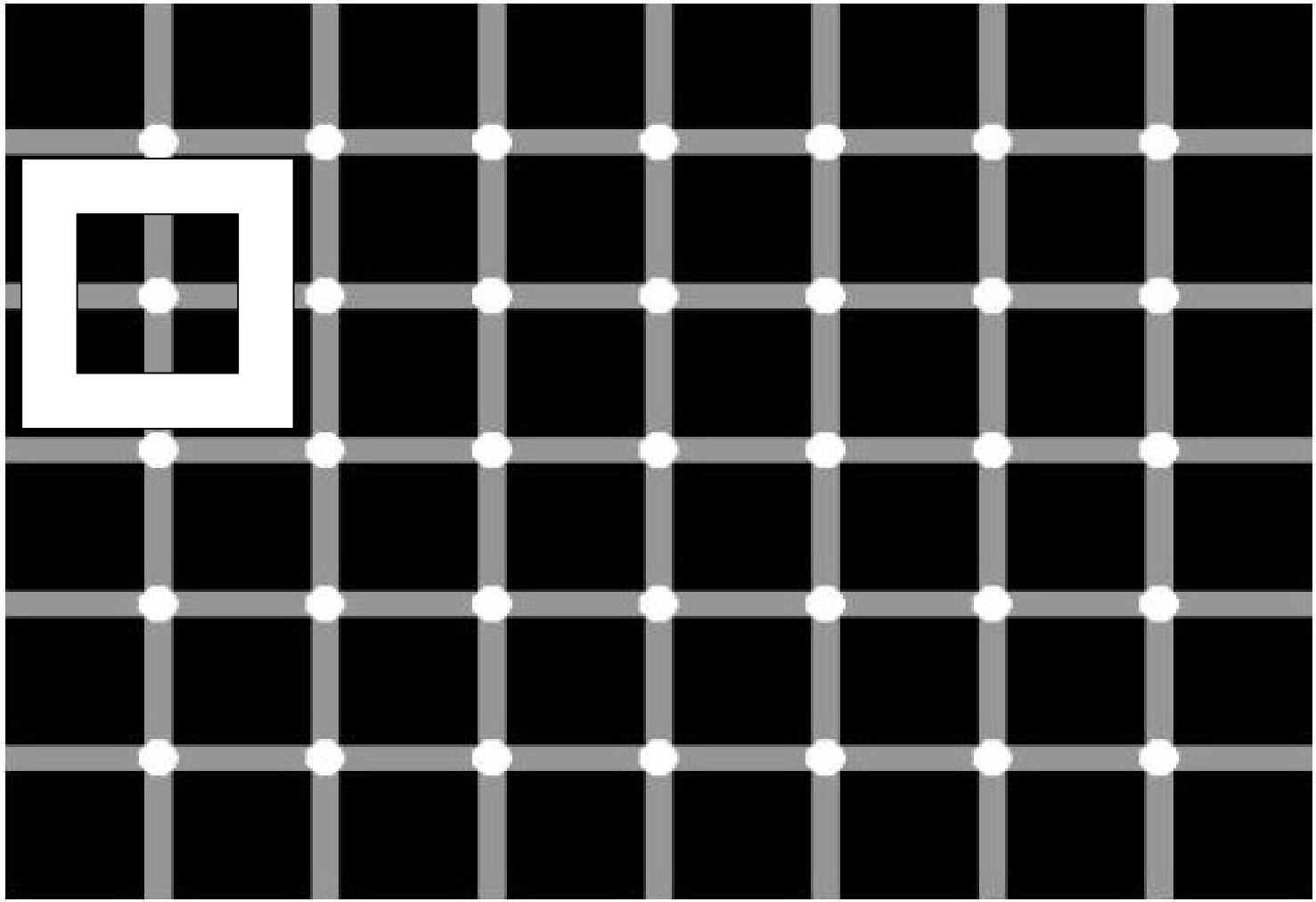


AMAZING EFFECTS



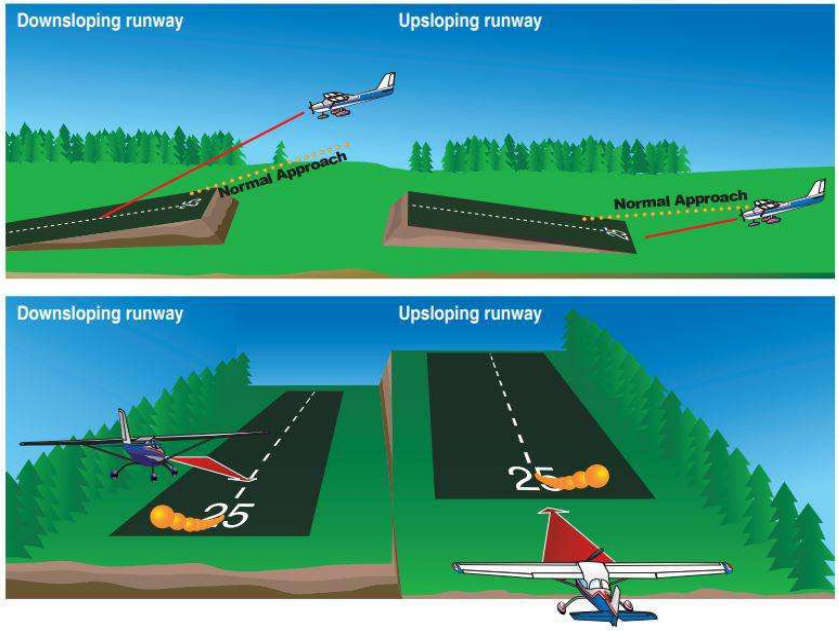


COUNT THE BLACK DOTS



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.**

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

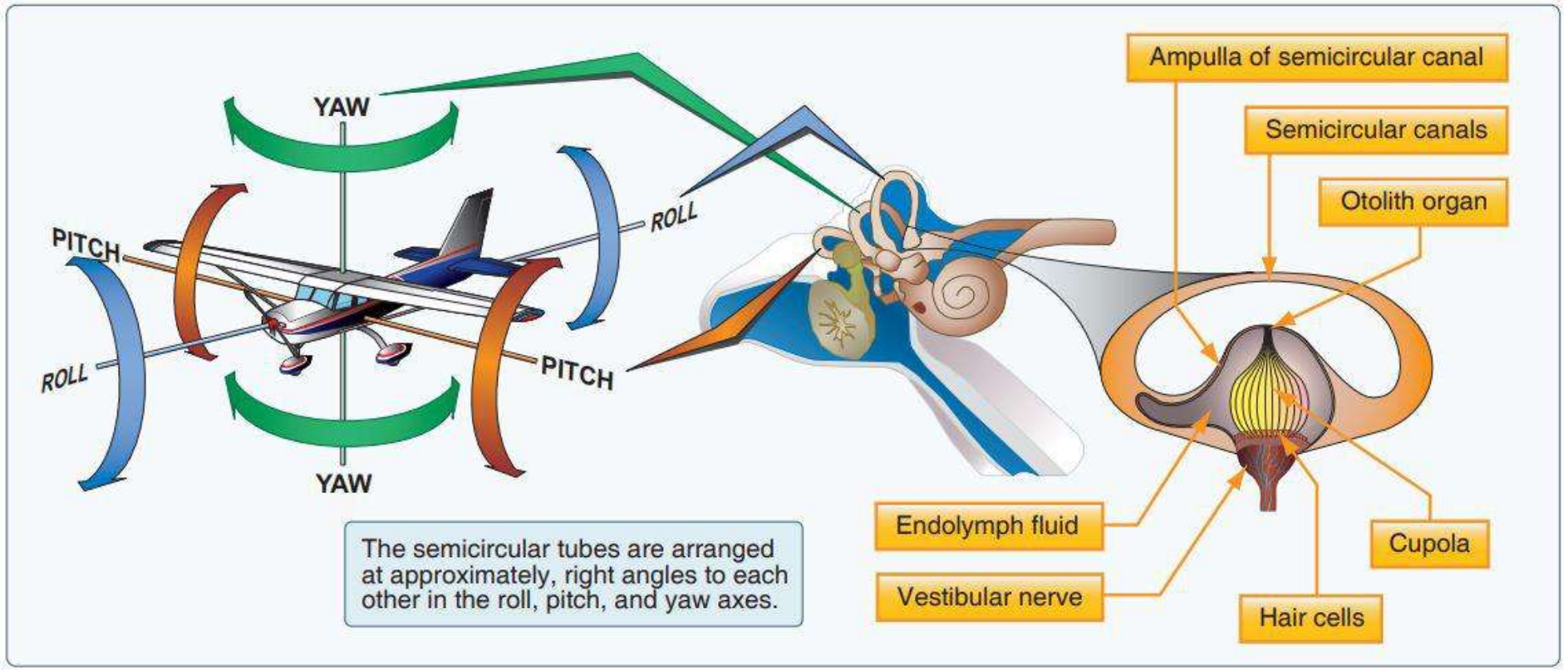
SPATIAL DISORIENTATION

- 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)

SPATIAL DISORIENTATION

- The body uses 3 integrated systems to assess orientation and movement in space :
  - Vestibular system—organs found in the inner ear that sense position by the way we are balanced
  - Somatosensory system—nerves in the skin, muscles, and joints that, along with hearing, sense position based on gravity, feeling, and sound
  - Visual system—eyes, which sense position based on what is seen
- The eyes often overcome the false signals that the other systems send to our brain as we are not meant to fly!

SPATIAL DISORIENTATION



The vestibular system

SPATIAL DISORIENTATION

- The leans: sudden return to level flight following a gradual and prolonged turn unnoticed by pilot:
  - Turn of 2 degrees or lower are below the detection threshold of the semi-circular system
  - Levelling the wings after such a turn may cause illusion that the aircraft is banking in the opposite direction
- Coriolis illusion: turning the head during the aircraft turn produce the illusion that the aircraft is banking, yawing, or pitching when it is not
- Somatographic illusion:
  - illusion being in a nose-up attitude, especially in conditions with poor visual references.
  - disoriented pilot may push the aircraft into a nose-low or dive attitude.
  - accelerating will produce a feeling of being nose up and decelerating gives a feeling of being nose down

SOMATOGRAPHIC ILLUSION

GULF AIR FLIGHT 072

- Scheduled international passenger flight from Cairo International Airport in Egypt to Bahrain International Airport in 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
- The flight crew suffered from spatial disorientation during the go-around and crashed into the waters 5 km from the airport
- Causes of the accident:
  - non adherence to a number of SOPs and loss of spatial 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

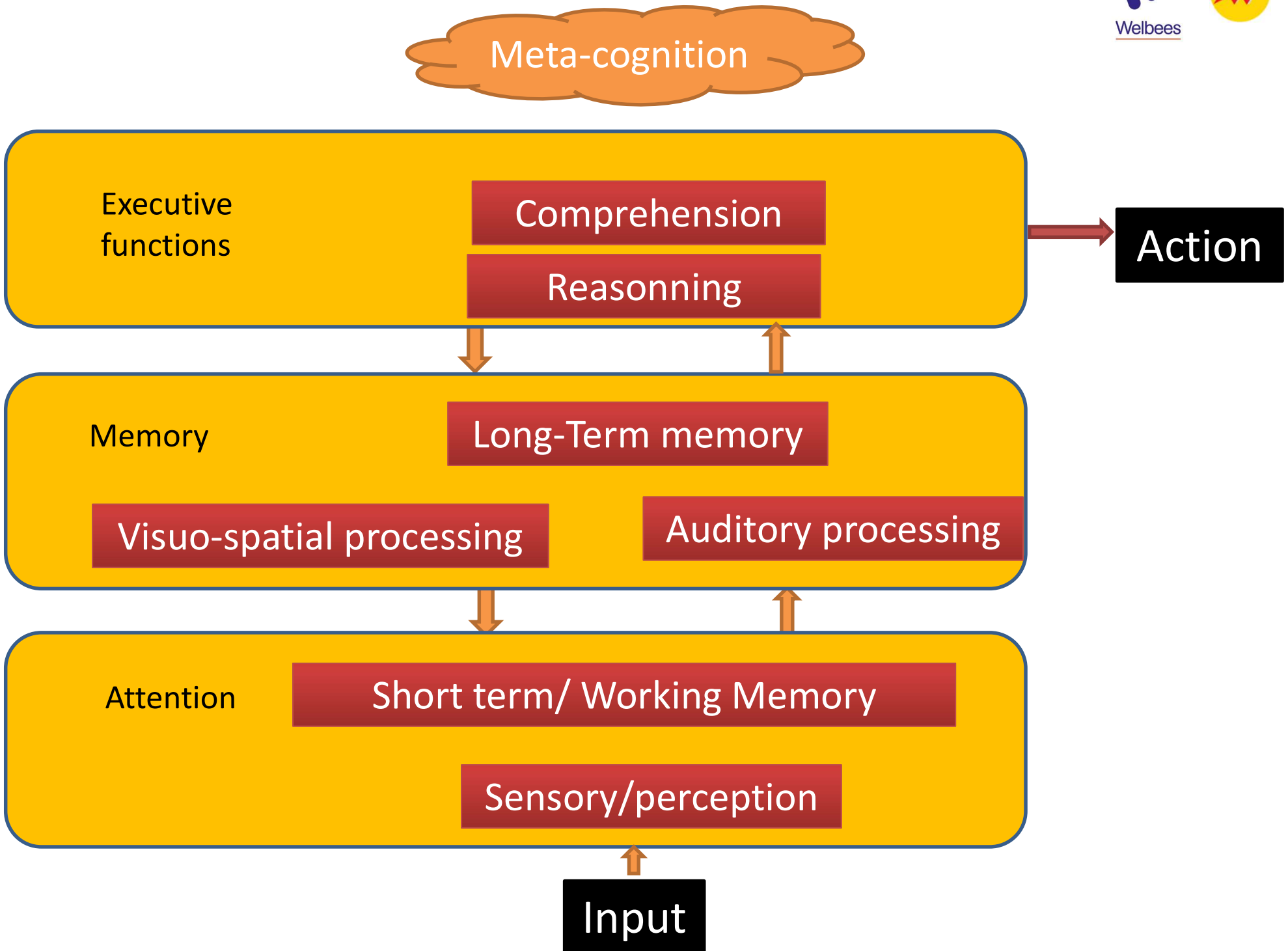
THE MACGURK EFFECT

COGNITION

COGNITIVE FUNCTIONS

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

COGNITIVE PROCESS



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** is a cognitive system with a limited capacity that is responsible for temporarily holding information available for processing. Working memory is important for reasoning and the guidance of decision-making and behavior
- Fed with environment perception and knowledge in Long Term Memory.

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

In case of memory overload: unconscious release of information

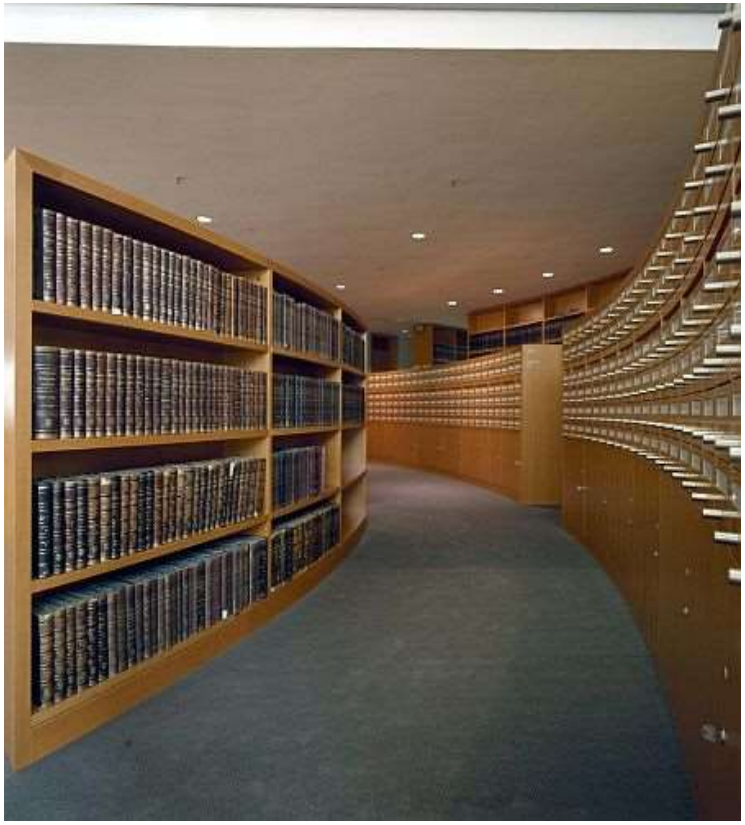
WORKING MEMORY TEST

- N-Back test : the subject is presented with a sequence of stimuli, and the task consists of indicating when the current stimulus matches the one from *n* steps earlier in the sequence. The load factor *n* can be adjusted to make the task more or less difficult

https://www.psytoolkit.org/experiment-library/experiment_nback.html

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**

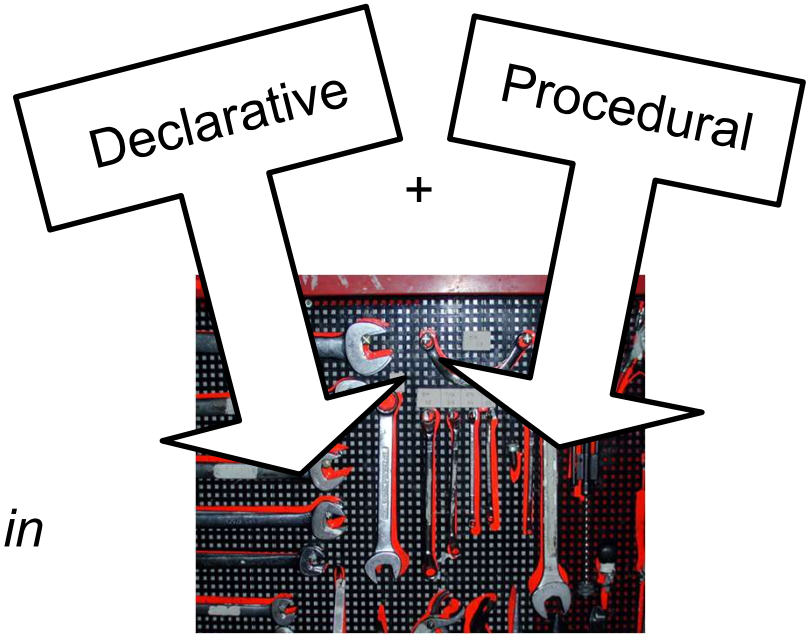
When we know "that":
continents, HDMI plug exists…

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 ENAC 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.

SCHEMA

- An effective tool for understanding the world, most everyday situations do not require effortful processing - automatic processing is all that is required.
- New perceptions are organized into schema to act effectively without effort,
- For example we have a stairway schema and can apply it to climb staircases we never seen before.
- Each situation is not a new problem (what to do, how to achieve…). We have predefined answers in mind.

SCHEMA

- However, changing schemata is costly and painful. We prefer to keep older forms than to define new one. This explain why:
  - We don't read user's guide
  - We type "Return, return, return" without reading software windows…
  - We prefer to use a well known schema instead of an efficient one but rarely used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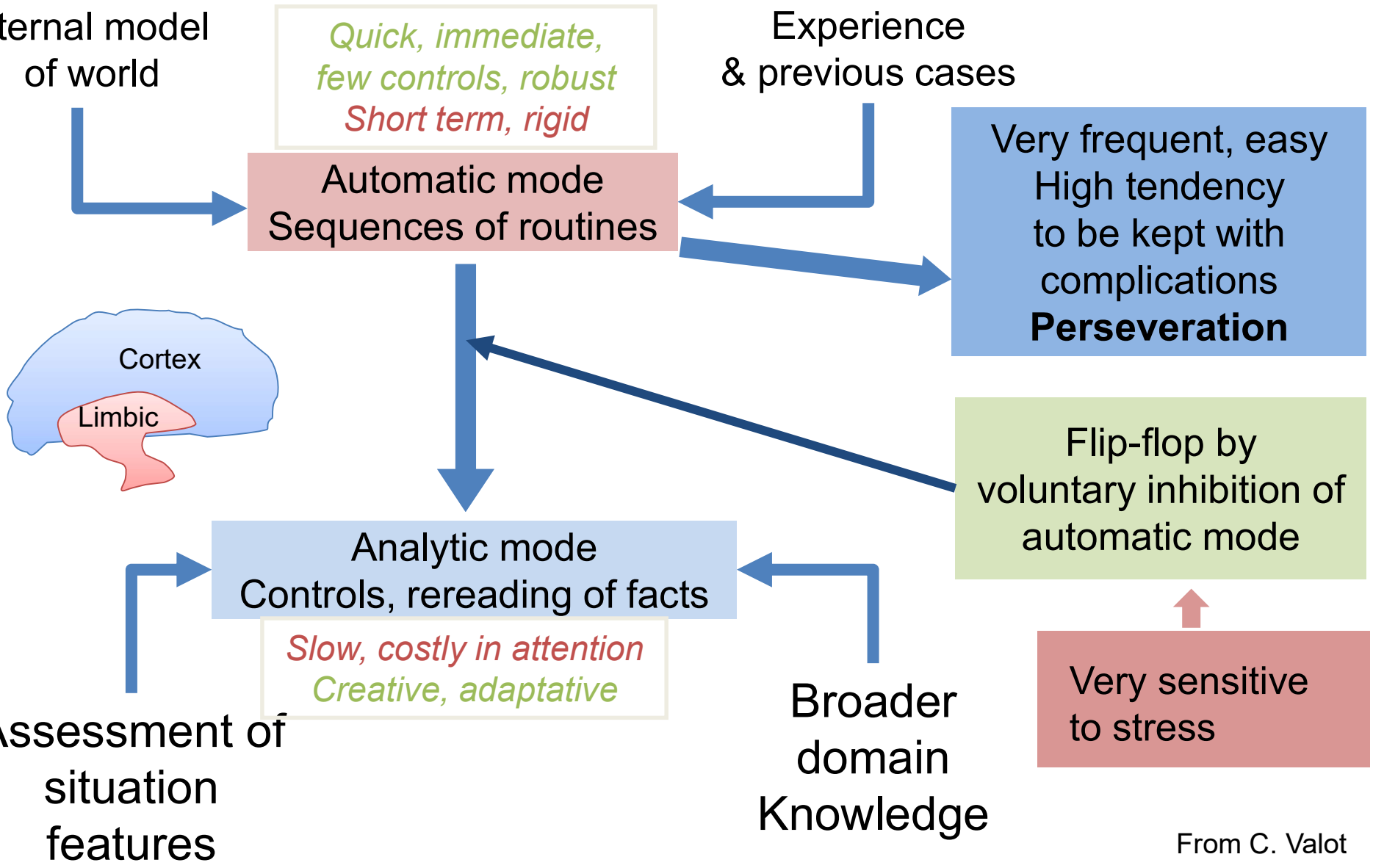
HUMAN: AUTOMATIC AND ANALYTIC MODES

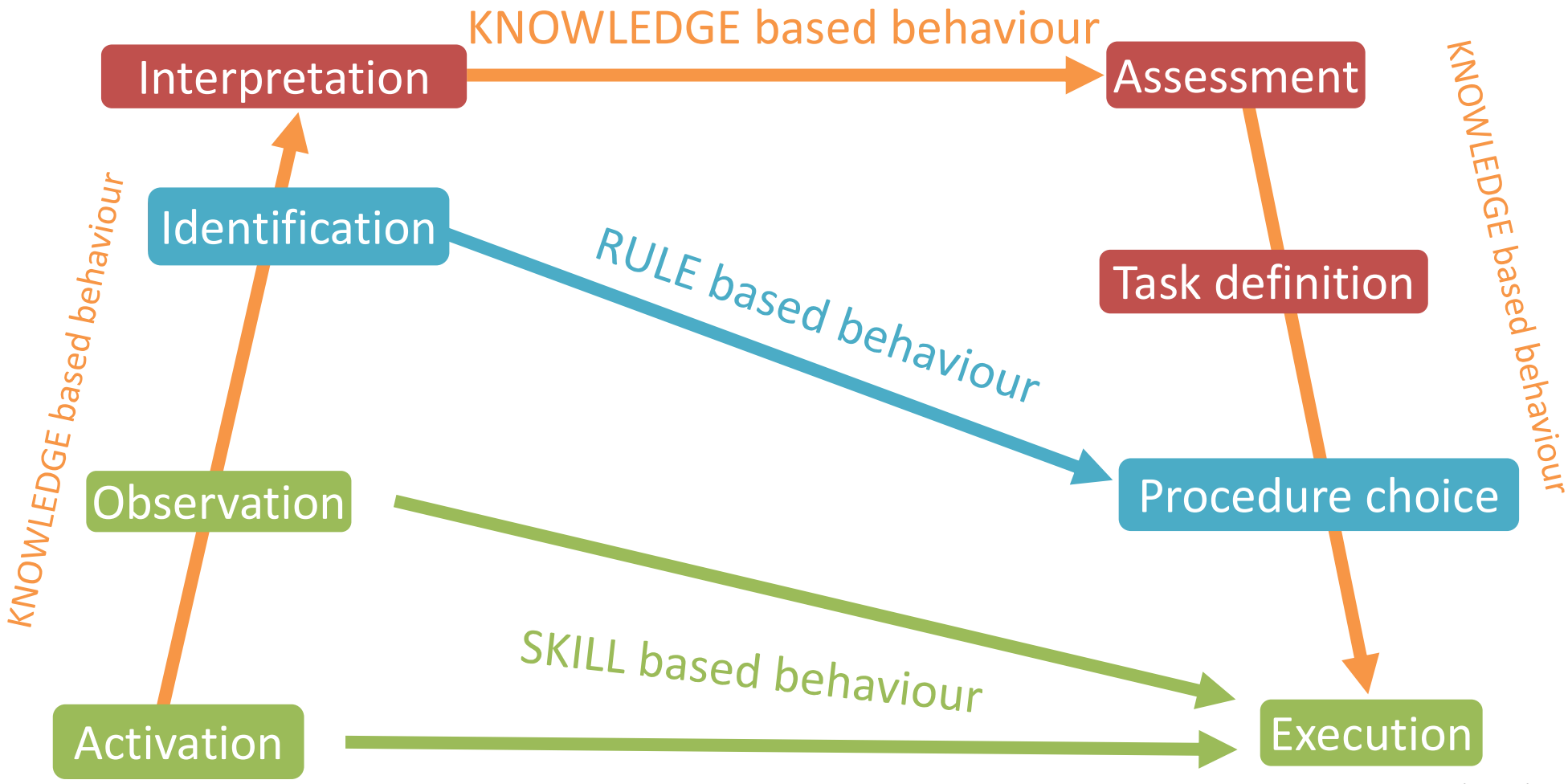


From C. Valot

SRK MODEL

- Cognitive psychologist (Rasmussen) distinguished "skill-based" performance, "rule-based" performance, and "knowledge-based" performance.
- Skills are highly practiced behaviors that we perform routinely, with little conscious effort. They're literally automatic.
- Rule and Knowledge-based performance requires more mental involvement or conscious deliberation.
- We rely on them when skill-based performance do not work, typically in exceptional or novel situations.

ACTIVITY CONTROL: SRK MODEL (RASMUSSEN) FROM DISCOVERY TO ROUTINES



Step ladder - Jens Rasmussen (1988)

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'

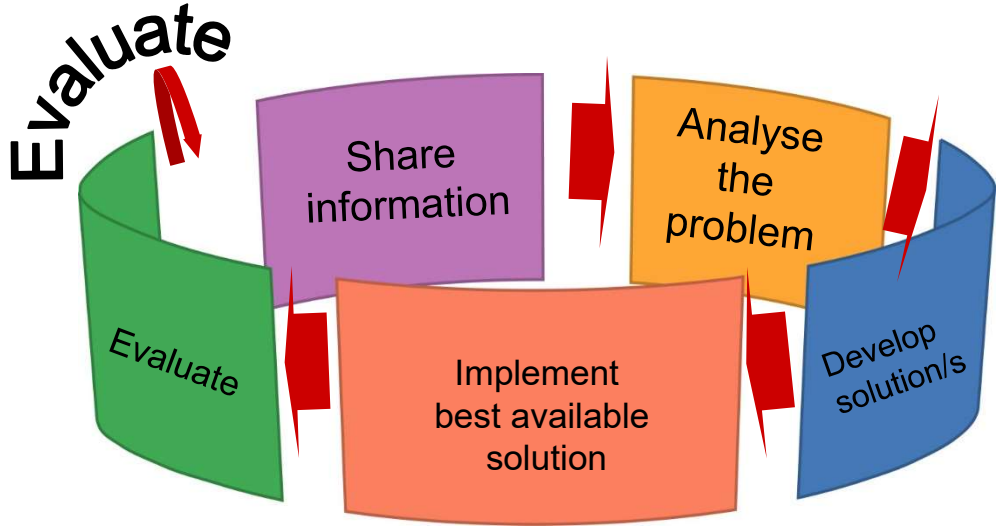
S hare the information

A nalyse the problem

D evelop solutions

I mplement the best solution

E valuate (continually)

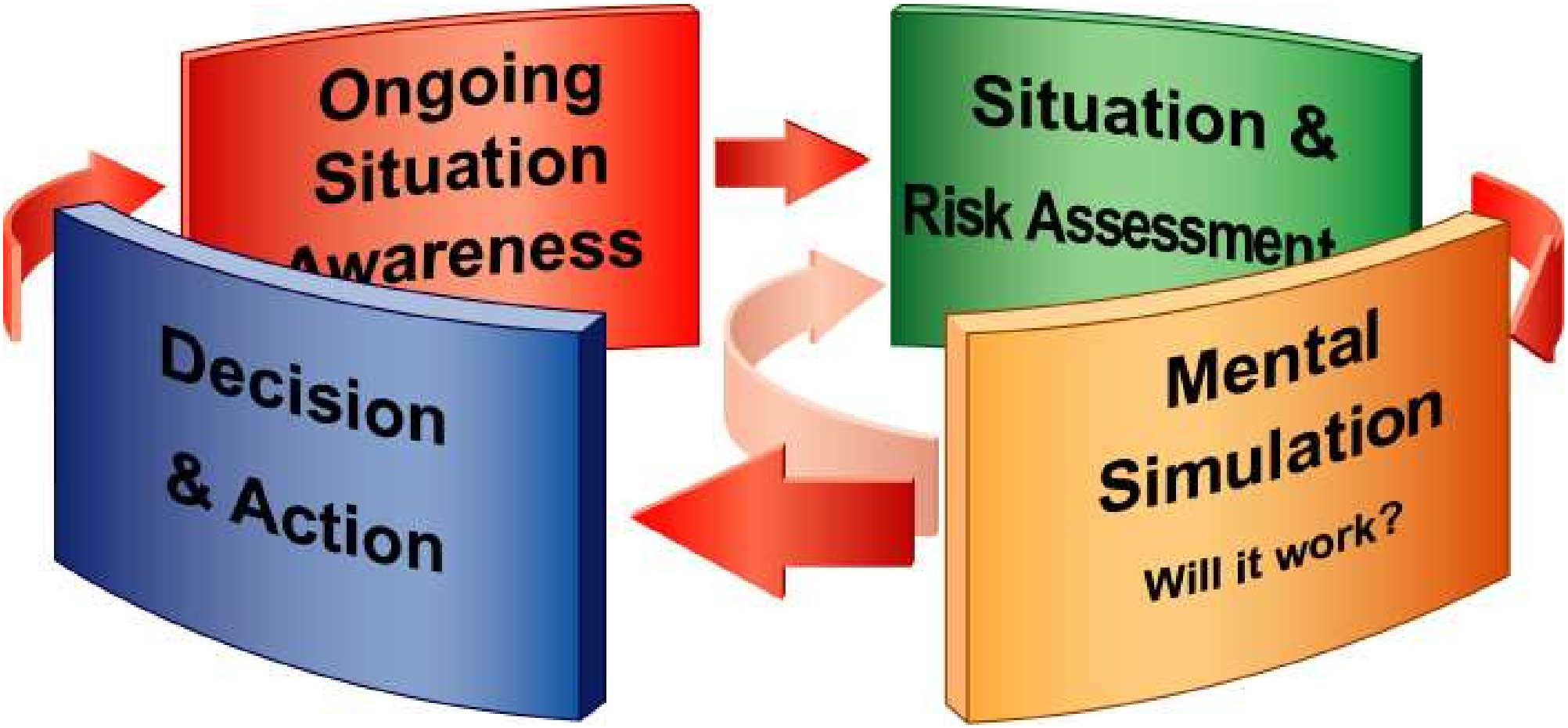


(Adapted from Australian Airlines' ATM Program)

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



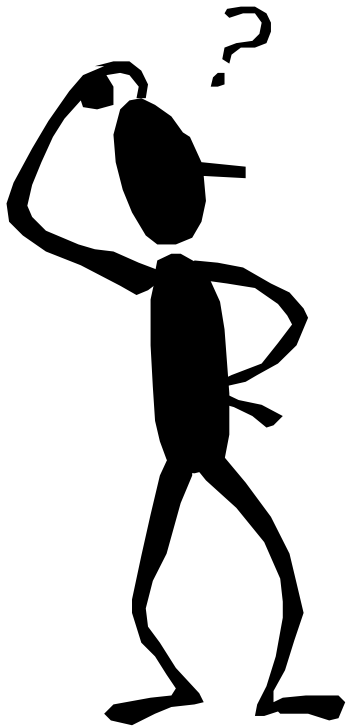
INTUITIVE DECISION MAKING

- 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?

INTUITIVE DECISION MAKING WORKS BEST WHEN…

- Time is critical
- The situation is changing quickly and / or unclear
- There is an immediate threat and *something* must be done
- People have the experience to act intuitively
- Any adequate outcome will do

SMALL GROUP ACTIVITY:
ANALYTICAL VS INTUITIVE?



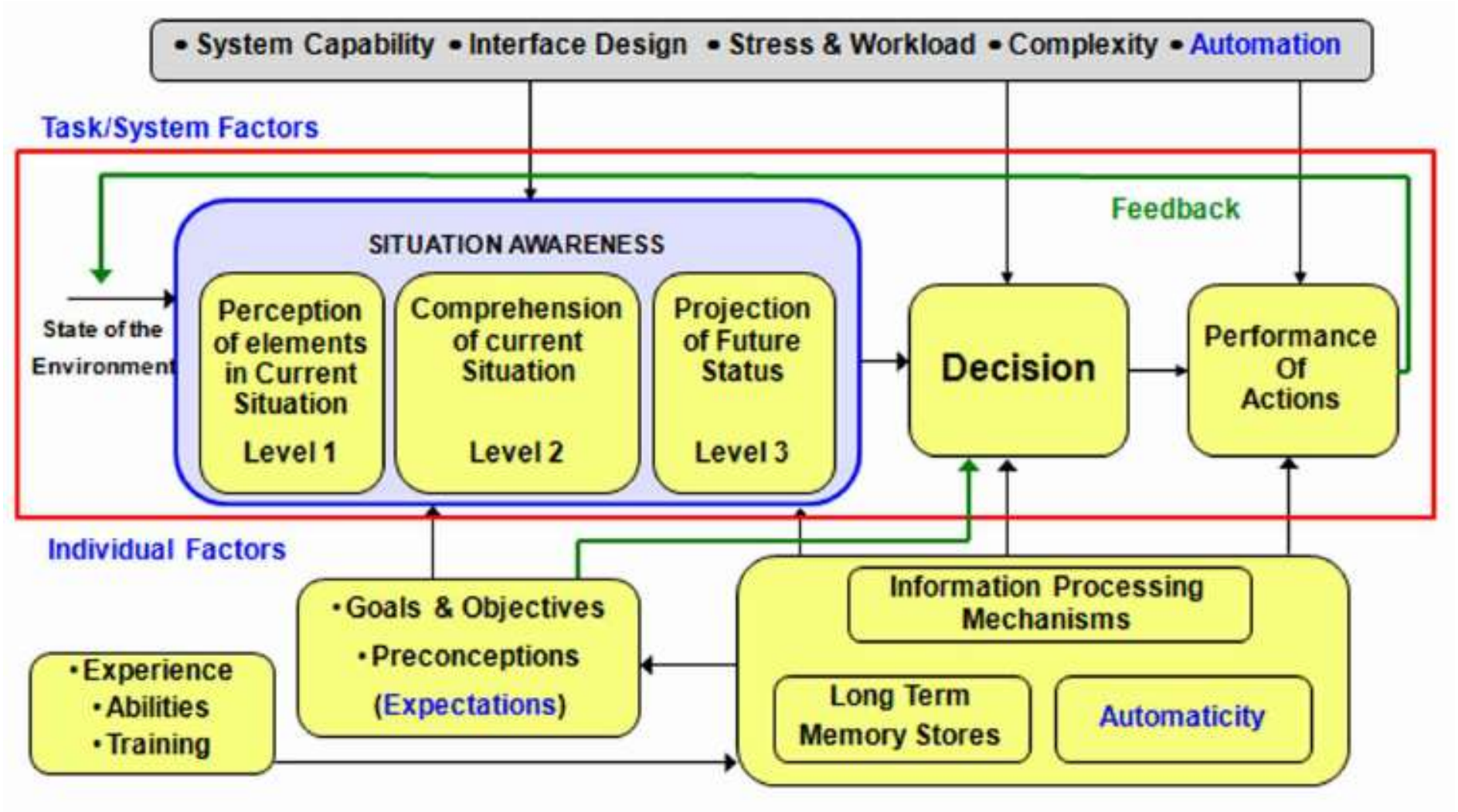
Examples of situations where:

- Analytical decision making is best?
- Intuitive decision making is best?

SITUATION AWARENESS

- The perception of environmental elements and events with respect to time or space, the comprehension of their meaning, and the projection of their future status.
- Having a clear and up to date understanding of what is going on around us

SITUATION AWARENESS



HOW TO DETECT A LOSS OF SA?

Clues that you might be missing something:

- Unexplained discrepancies
  - Unusual timing
  - Unexpected results
  - Communication mismatch
- GPWS warning
- “Something seems strange, it doesn’t feel right”
- Healthy doubt, …

HOW TO RECOVER FROM A LOSS OF SA?

- Communicate:
  - Express any doubt
  - Ask for external assistance
- Set time deadlines to act
- Avoid fixation on the past problems
  - debrief problems after the flight

Keep It Simple Stable and Safe (KISSS)

- Go back to the big picture
  - go to the last thing you were certain of
- Change the information source:
  - use raw data
  - basic information
  - external inputs
- Change the automation level (or take over)

SMALL GROUP ACTIVITY

- Provide and comment one example of accidents due to loss of situation awareness
- How this accident could have been prevented?

ATTENTIO N

- 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

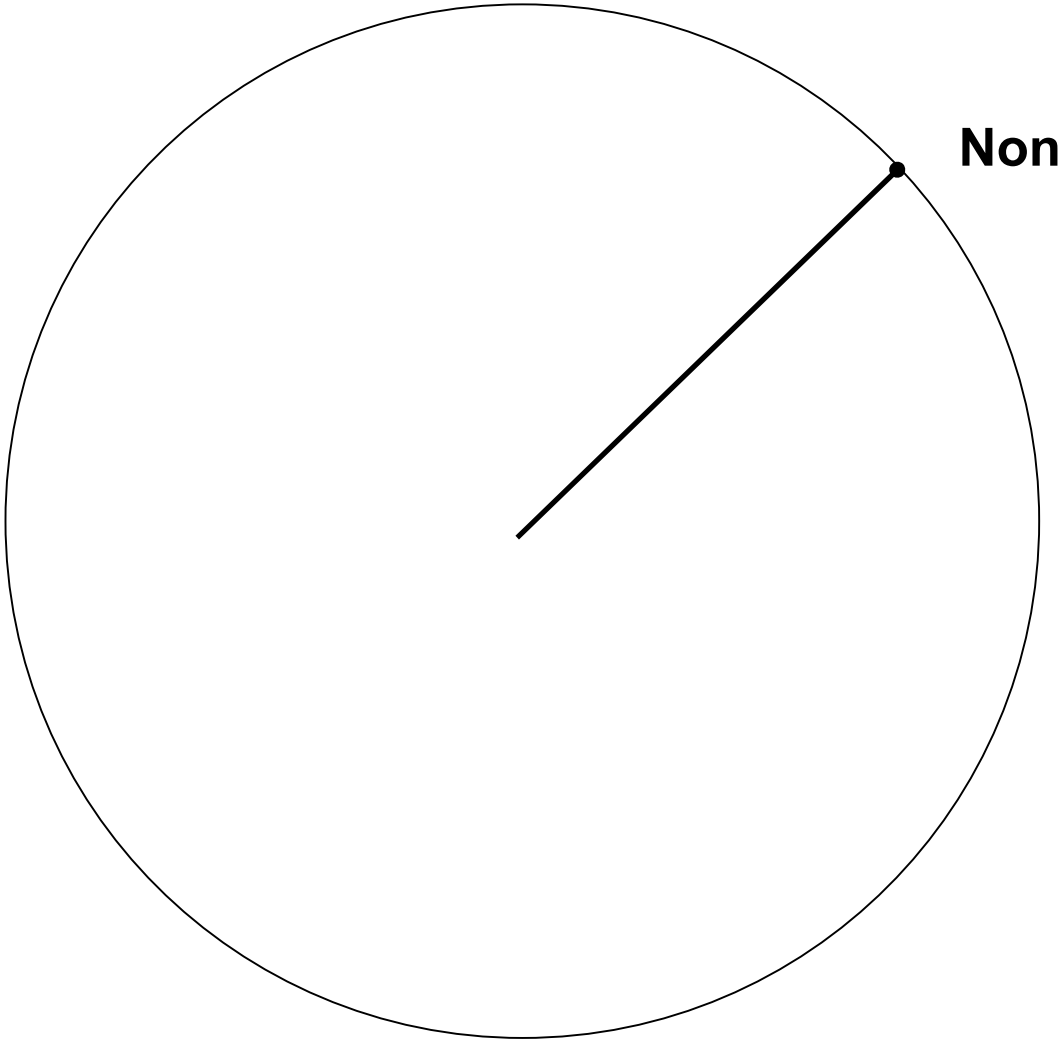
- **Focused attention:** ability to respond discretely to specific visual, auditory or tactile stimuli
- **Sustained attention:** ability to maintain a consistent behavioural response during continuous and repetitive activity
- **Selective attention:** capacity to maintain a behavioural or cognitive 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


THE ATTENTION TEST

VIGILANCE

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

THE CLOCK TEST (MACKWORTH, 1950)



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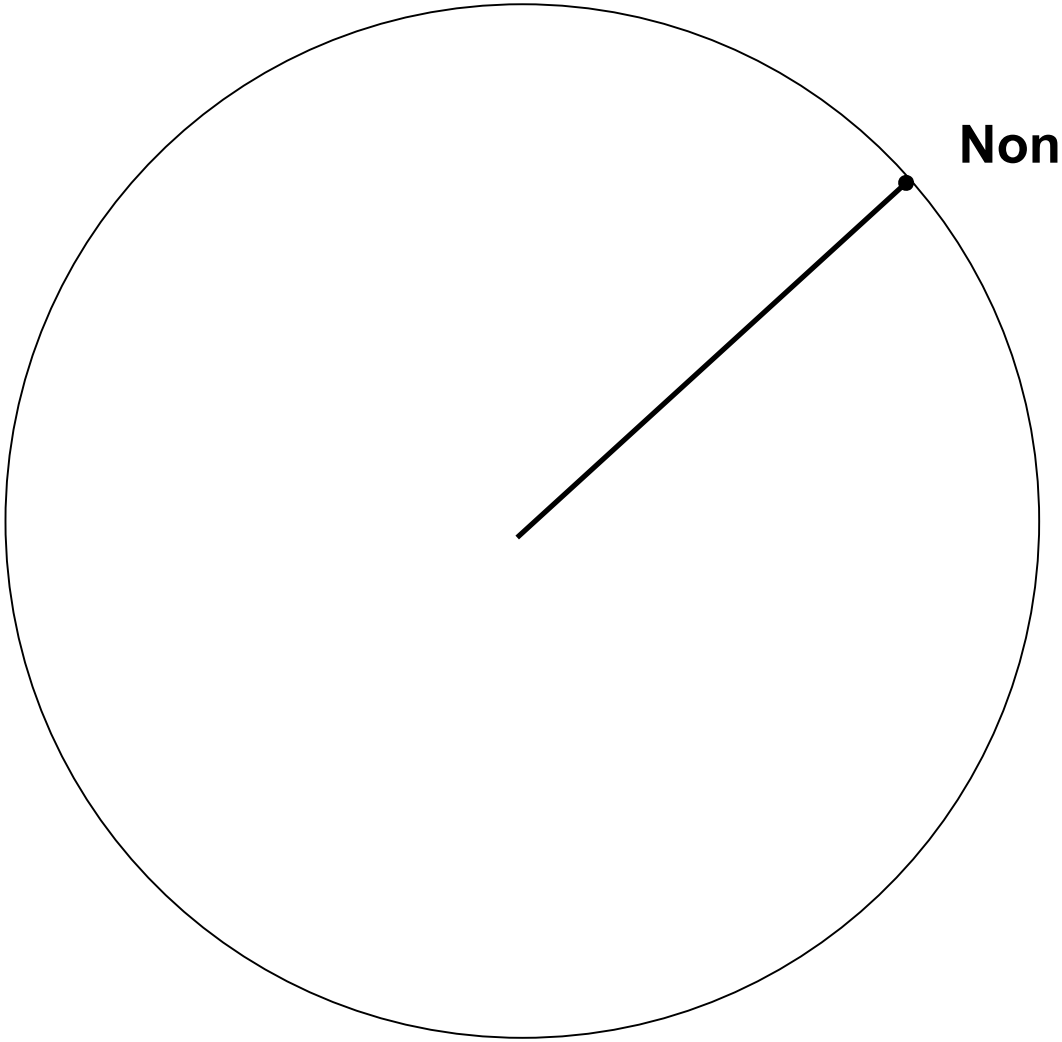

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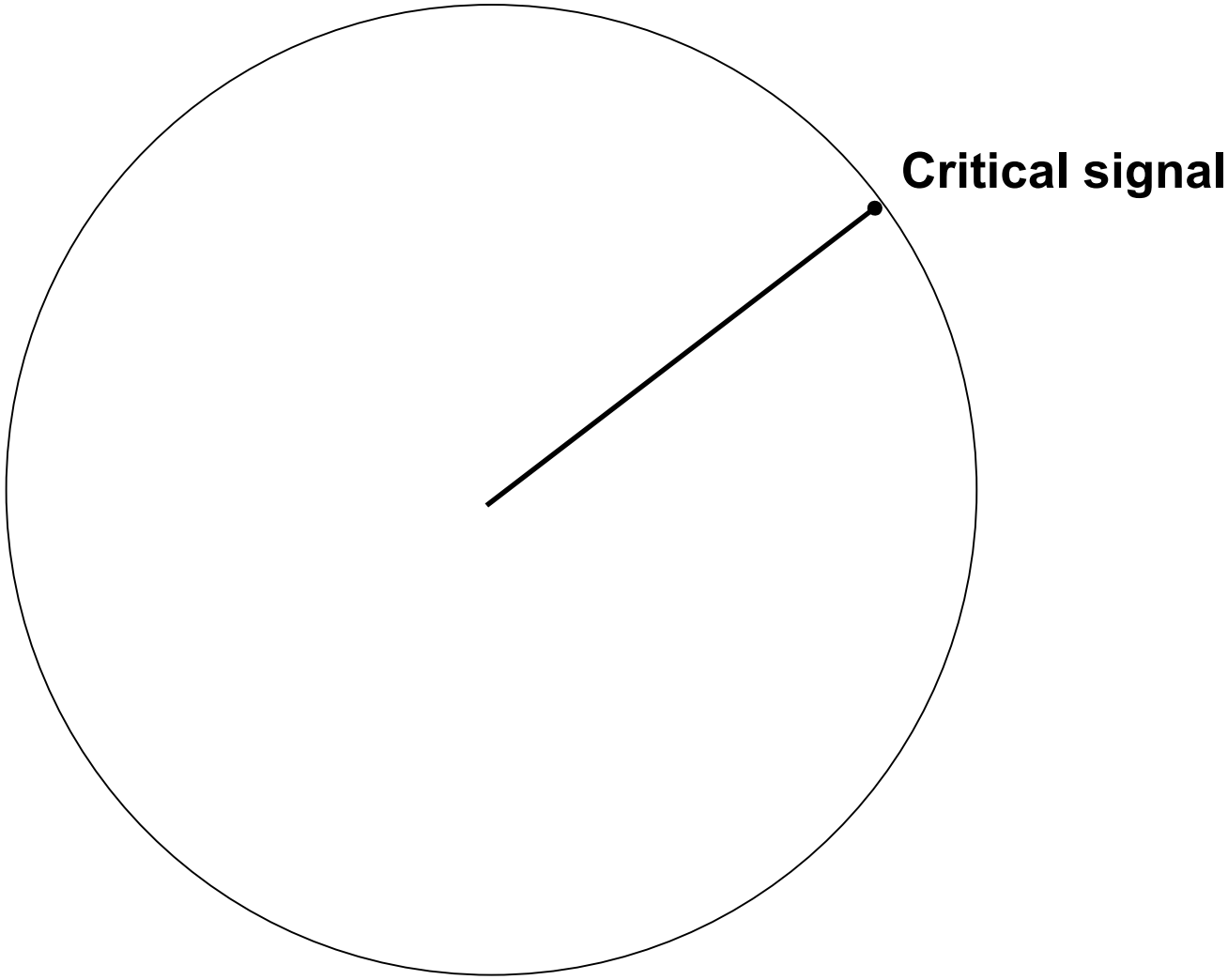
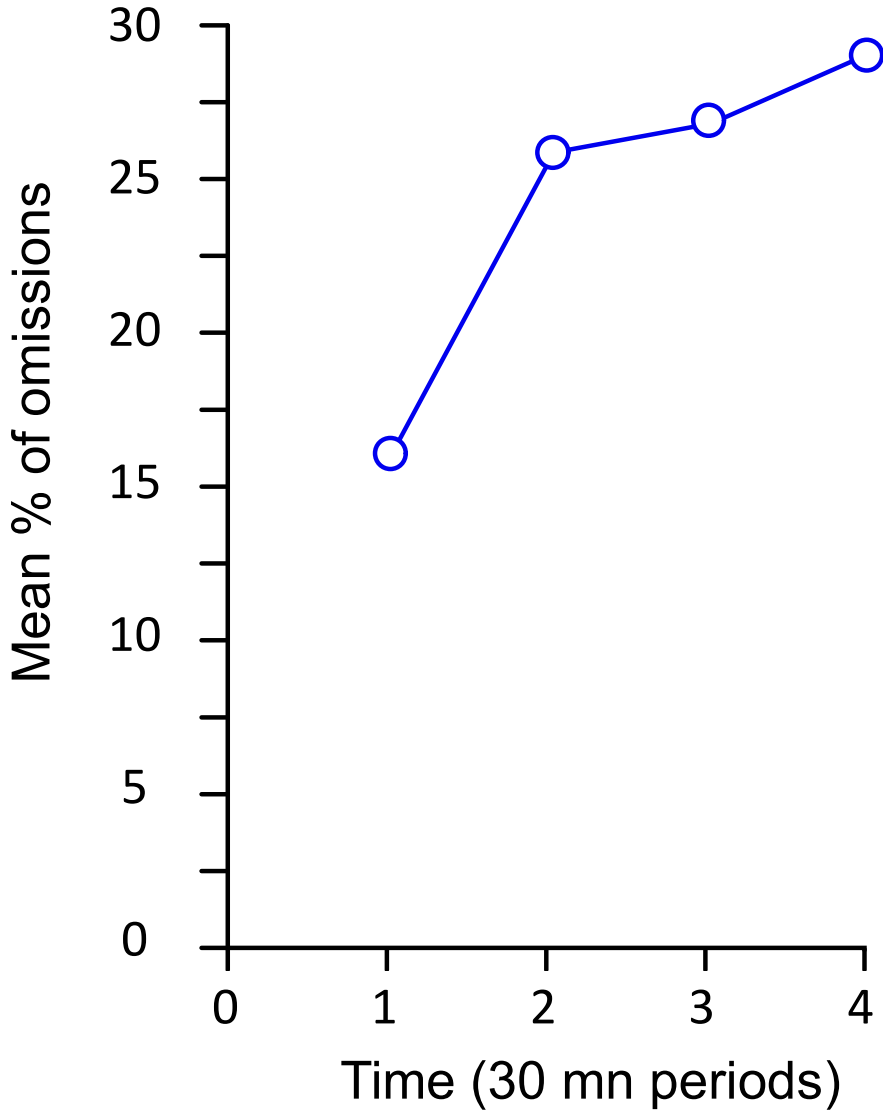


VIGILANCE DECREMENT IN THE CLOCK TEST (MACKWORTH, 1950)



(Mackworth, 1950)

FATIGUE AND SLEEP

More than 80 fatigue related recommendations since 1989

NTSB MOST WANTED LIST

AVIATION: The Federal Aviation Administration should:

Improve Oversight of Pilot Proficiency

- Evaluate prior flight check failures for pilot applicants before hiring.
- Provide training and additional oversight that considers full performance histories for [illegible]embers demonstrating performance deficiencies.

- Instal[illegible]knits to give investigators more information to solve complex acci[illegible]

Improve the Safety of Emergency Me[illegible]

- Conduct all flights with medical personnel on board in ac[illegible] aircraft regulations.
- Develop and implement flight risk evaluation programs for EMS operators.
- Require formalized dispatch and flight-following procedures including up-to-date weather information.
- Ins[illegible] ope[illegible]

Impr[illegible]

- Giv[illegible] coc[illegible]
- Re[illegible]
- Re[illegible] pilo[illegible]
- Re[illegible]

Redu[illegible]

- Use current research on freezing rain and large water droplets to revise the way aircraft are designed and approved for flight in icing conditions.
- Apply revised icing requirements to currently certificated aircraft.
- Require that airplanes with pneumatic deice boots activate the boots as soon as the airplane enters icing conditions.

NTSB classification : unacceptable response

Actions needed by Federal Agencies

Improve Crew Resource Management

- This issue area was removed from the Most Wanted List on March 15, 2011

Reduce Accidents and Incidents Caused by Human Fatigue in the Aviation Industry

- Set working hour limits for flight crews, aviation mechanics, and air traffic controllers based on fatigue research, circadian rhythms, and sleep and rest requirements.
- Develop guidance for operators to establish fatigue management systems, including a methodology that will continually assess the effectiveness of these systems.

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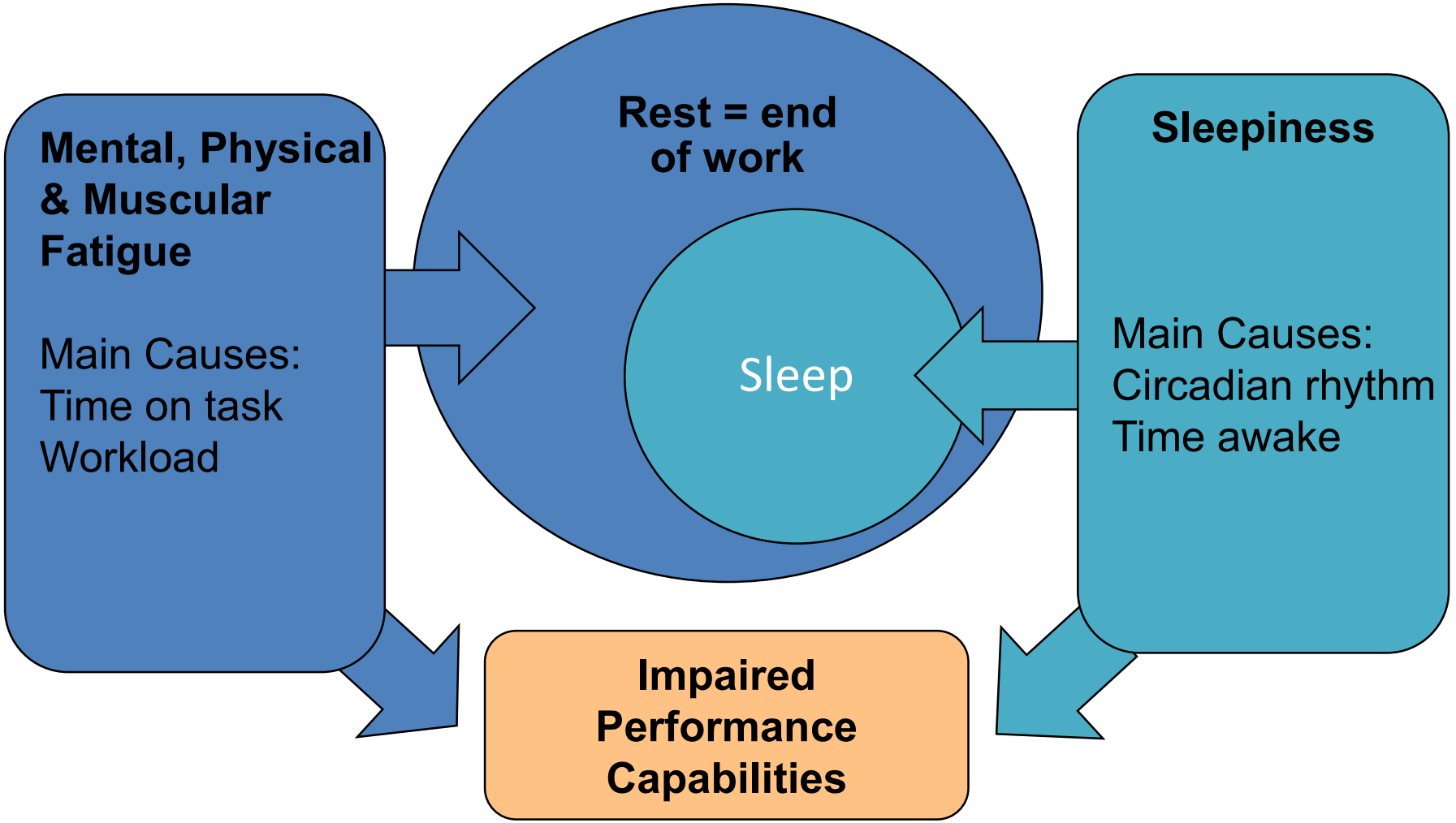
ACCIDENTS AT LEAST PARTIALLY ATTRIBUTED TO FATIGUE

	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

« FATIGUE IS A BIOLOGICAL DRIVE FOR A RECUPERATIVE REST »



Adapted from Folkard, 2008

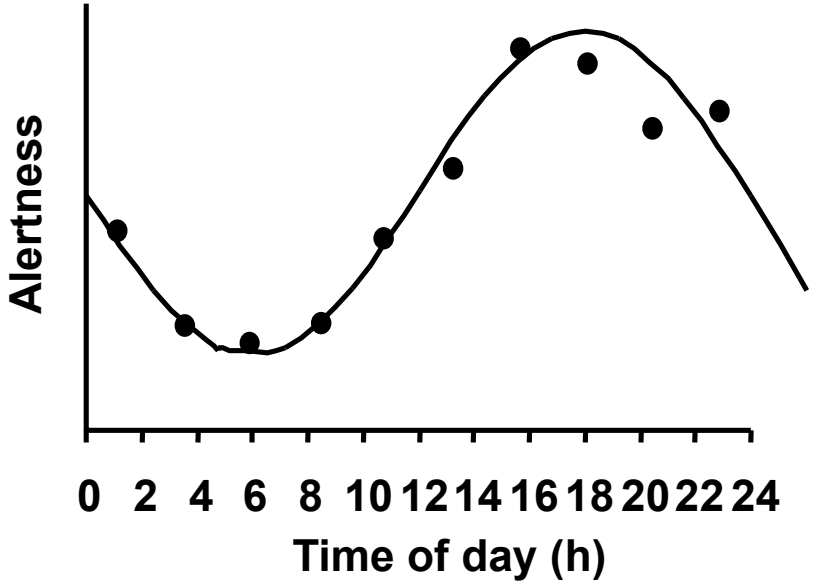
FATIGUE DEFINITION (FRMS GUIDE, ICAO 2011)

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**.

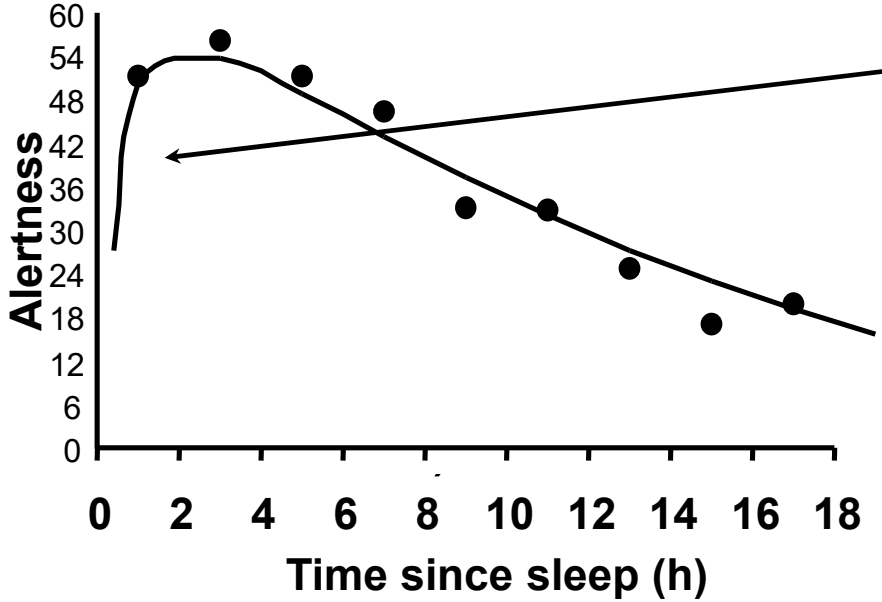
MAIN FATIGUE FACTORS IN AVIATION

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

ALERTNESS COMPONENTS: THE 3-PROCESS MODEL



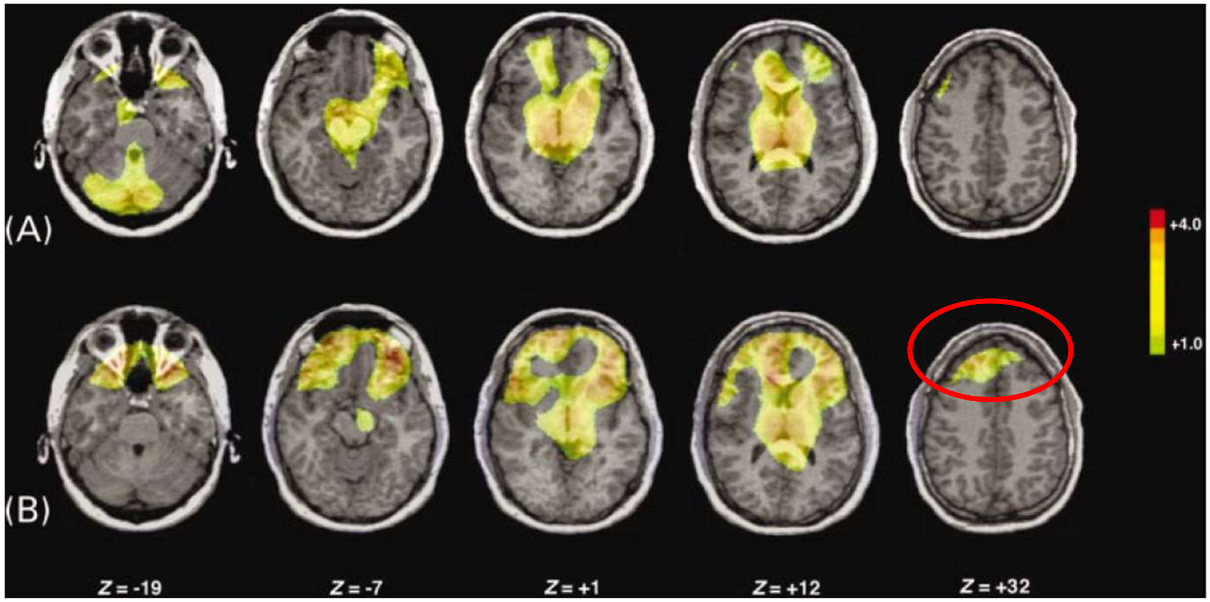
Process C (Clock)



Process W (Waking)

Process S (sleep)

BRAIN ACTIVATION AFTER AWEKENING (PROCESS W)

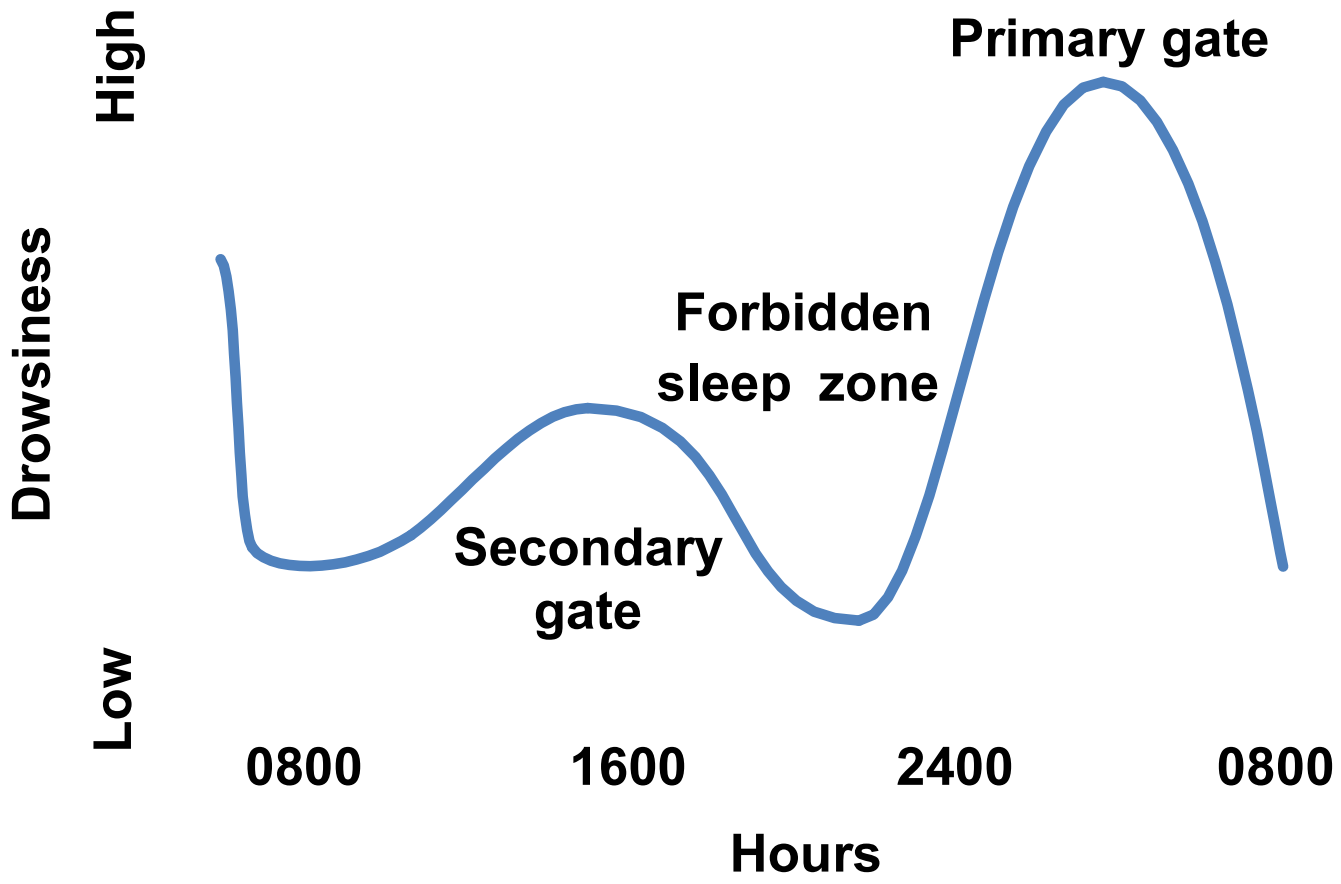


5 mn after awakening

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

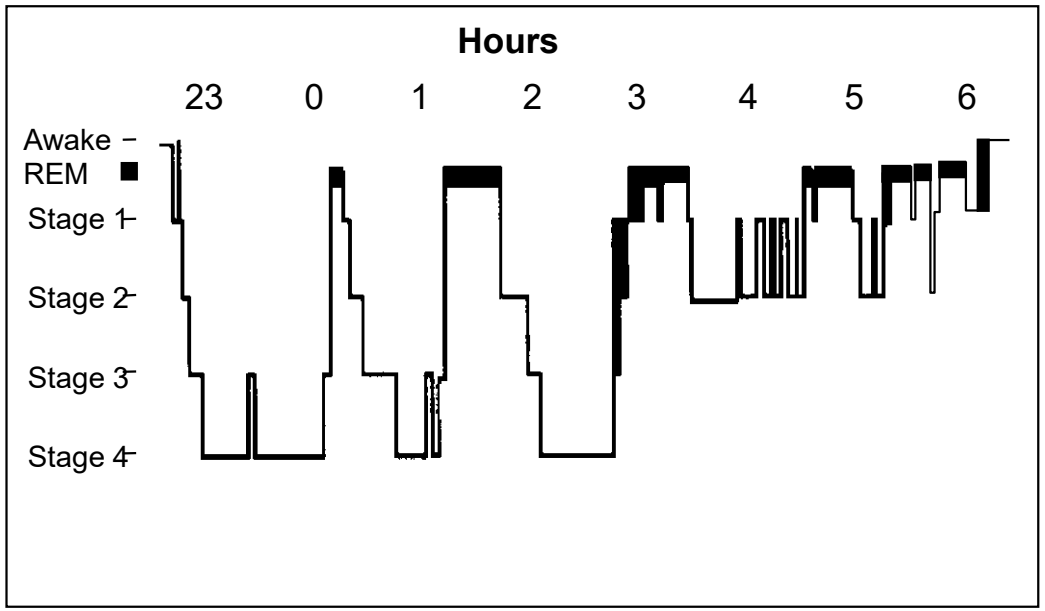
12 HOURS RHYTHM OF SLEEPINESS



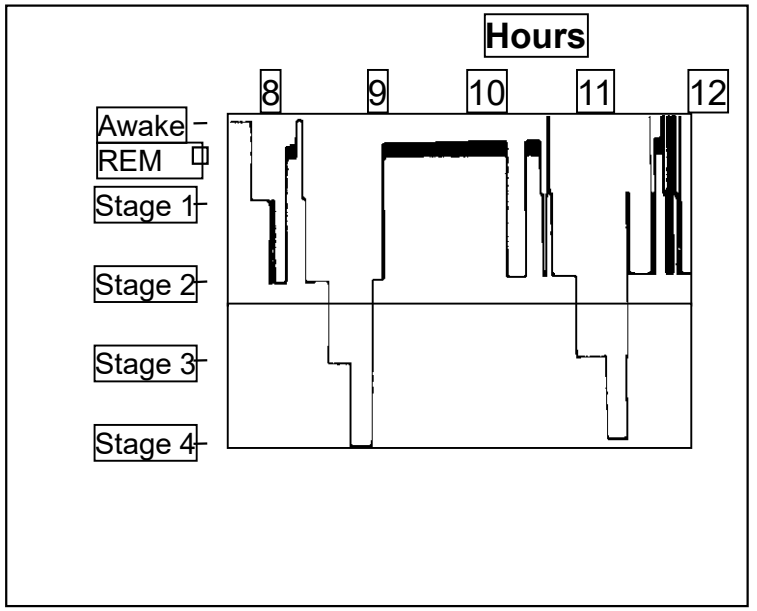
Schematic representation of time periods favoring sleep onset
(taken from Stampi, 1989)

SLEEP STRUCTURE

Normal



Disturbed
(e.g.: day sleep)



Recovery

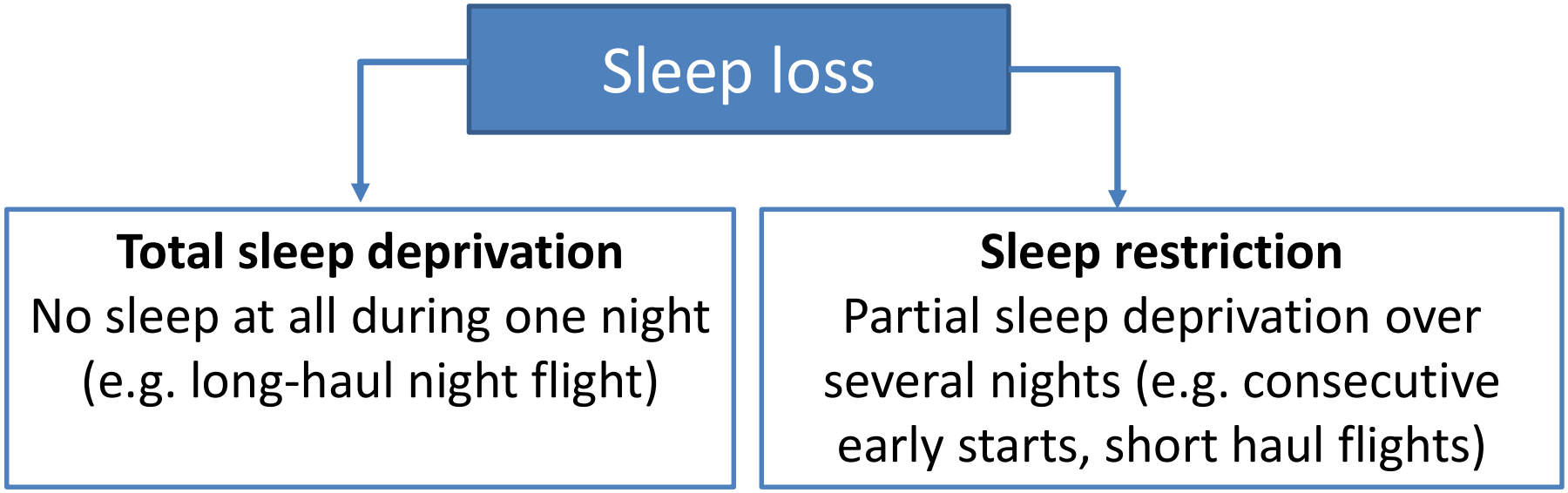
REM sleep

Stage 1 } **Light sleep**
Stage 2

Stage 3 } **Deep sleep**
Stage 4

Fatigue

SLEEP DEPRIVATION VERSUS SLEEP RESTRICTION



BLOOD ALCOHOL CONCENTRATION VS. SLEEP LOSS

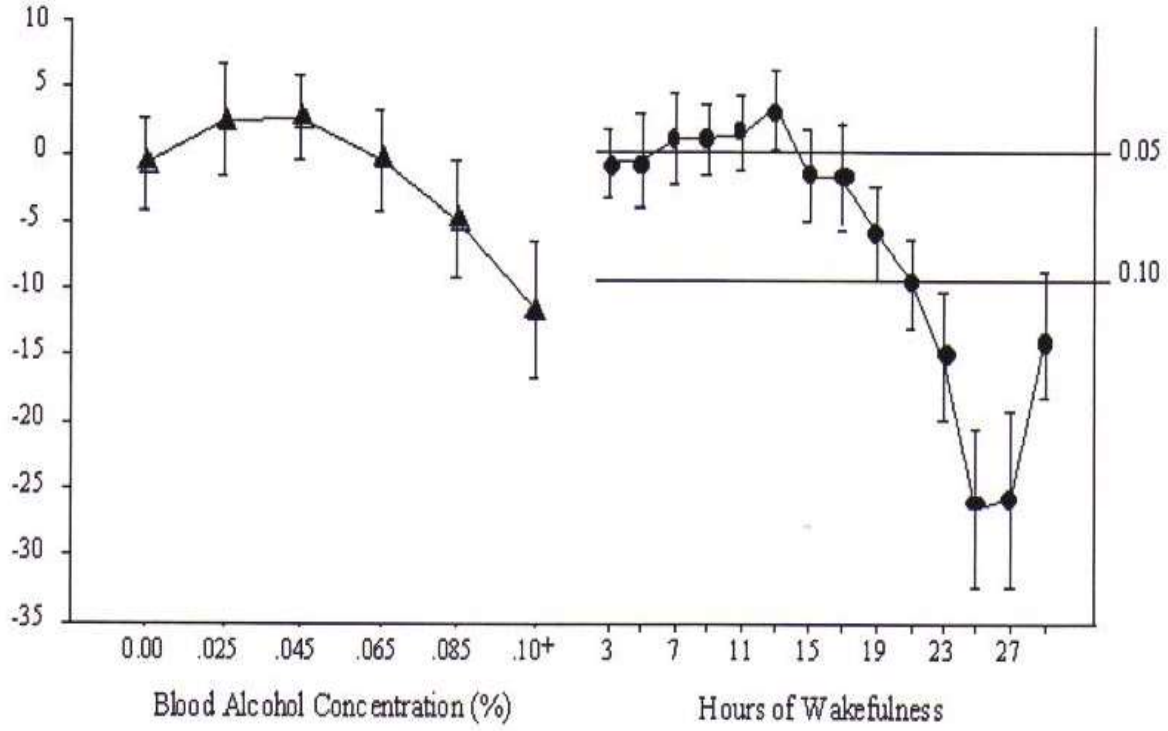


FIG. 1. Mean relative performance levels for the response latency component of the grammatical reasoning task in the alcohol intoxication (left) and sustained wakefulness condition. The equivalent performance decrement at a BAC of 0.05% and 0.10% are indicated on the right hand axis. Error bars indicate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

(Lamond and Dawson, 1999)

SLEEP LOSS AND PERFORMANCE

Effects on cognitive performance

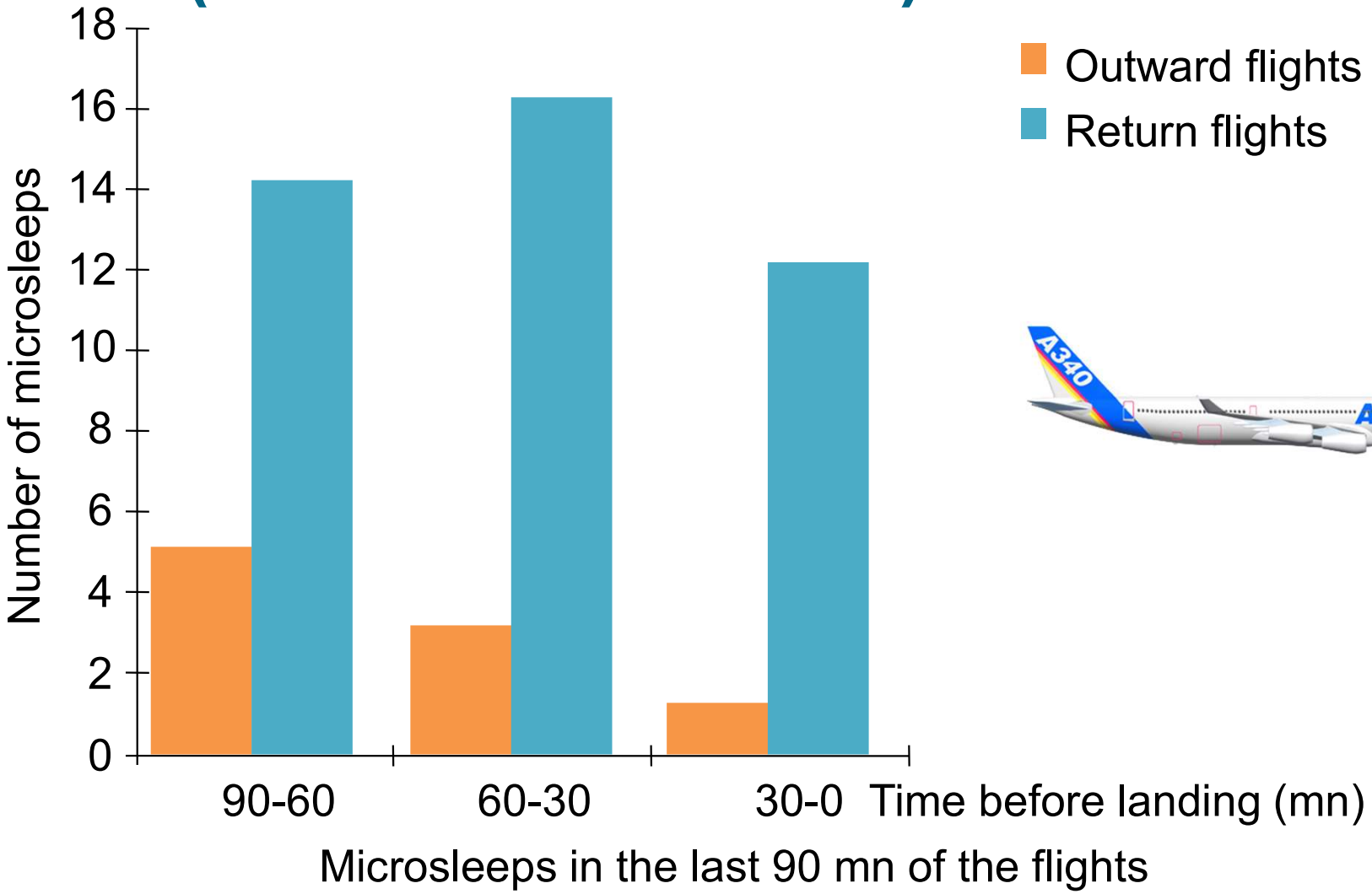
- Lack of concentration,
- Periods of inattention,
- Reduction in alertness level
- Slow (re)actions,
- Alteration in short-term memory,
- Loss of critical analysis and advocacy,
- Interpretation errors,
- Visual illusions,
- Disorientation in time and space.

Effects on Mood

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

MICROSLEEPS (LATE SLEEPINESS) DURING LONG-RANGE FLIGHTS

A340 CERTIFICATION FLIGHTS (TLS-SIN AND TLS-SFO)




DRIVECAM

FATIGUE SYMPTOMS

Physical Symptoms	Mental Symptoms	Emotional Symptoms
• Yawning repeatedly • Heavy eyelids or micro sleeps • Eye-rubbing • Nodding off or head drooping • Headaches, nausea, or upset stomach • Slowed reaction time • Lack of energy, weakness, or light headedness	• Difficulty concentrating on tasks • Lapses in attention • Failure to communicate important information • Failure to anticipate events or actions • Making mistakes even on well-practiced tasks • Forgetfulness • Difficulty thinking clearly • Poor decision making	• More quiet or withdrawn than normal • Lack of motivation to do the task well • Irritable or grumpy with colleagues, family, friends • Low morale

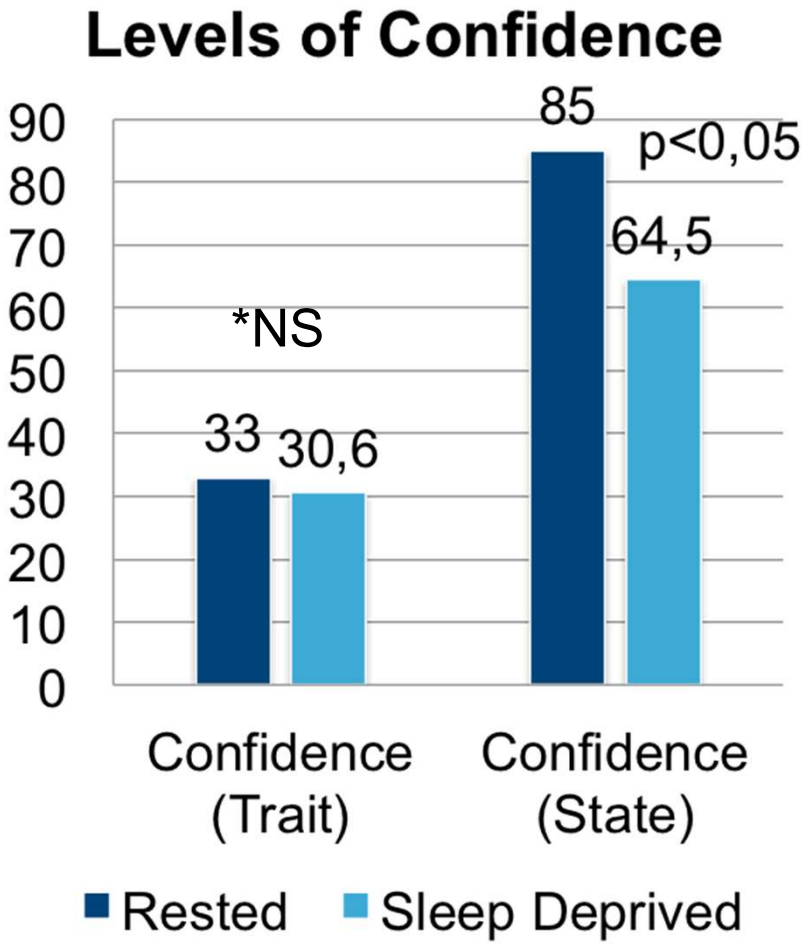
MAIN EFFECTS OF FATIGUE ON PERFORMANCE

- Sleep deprivation decreases:
- Innovation (divergent thinking)
- Flexibility of thought (revising plans)
- Competing distractions
- Effective communications
- Decision making under unexpected situations

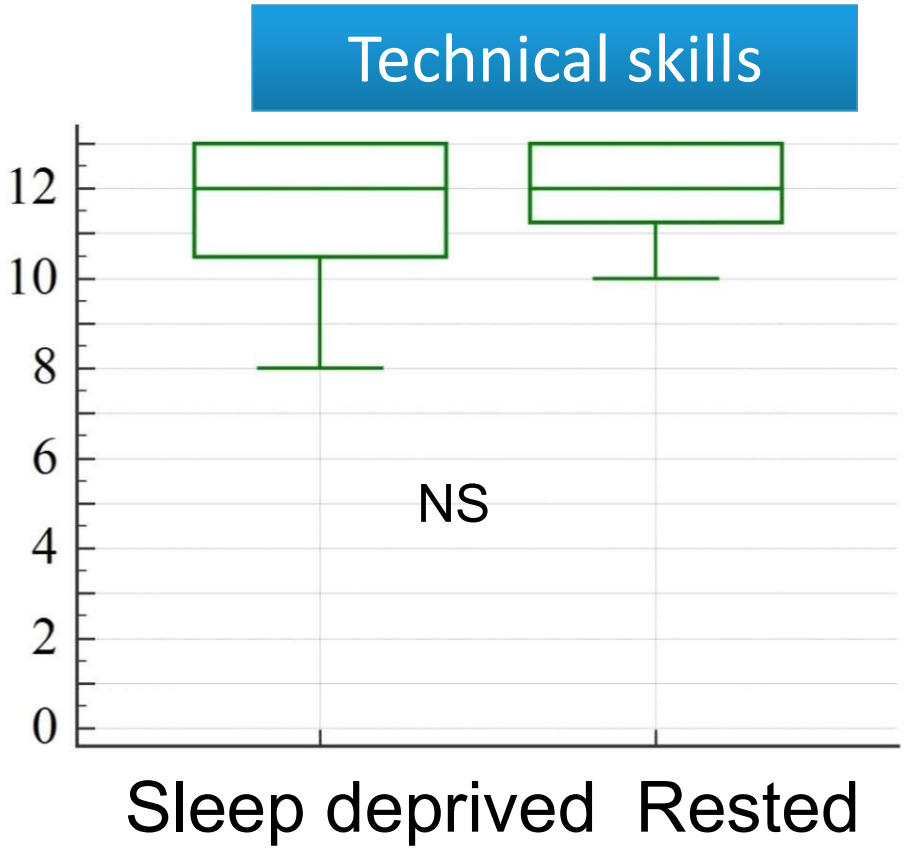
- Performance in "normal" situations are maintained
- at the cost of a compensatory effort

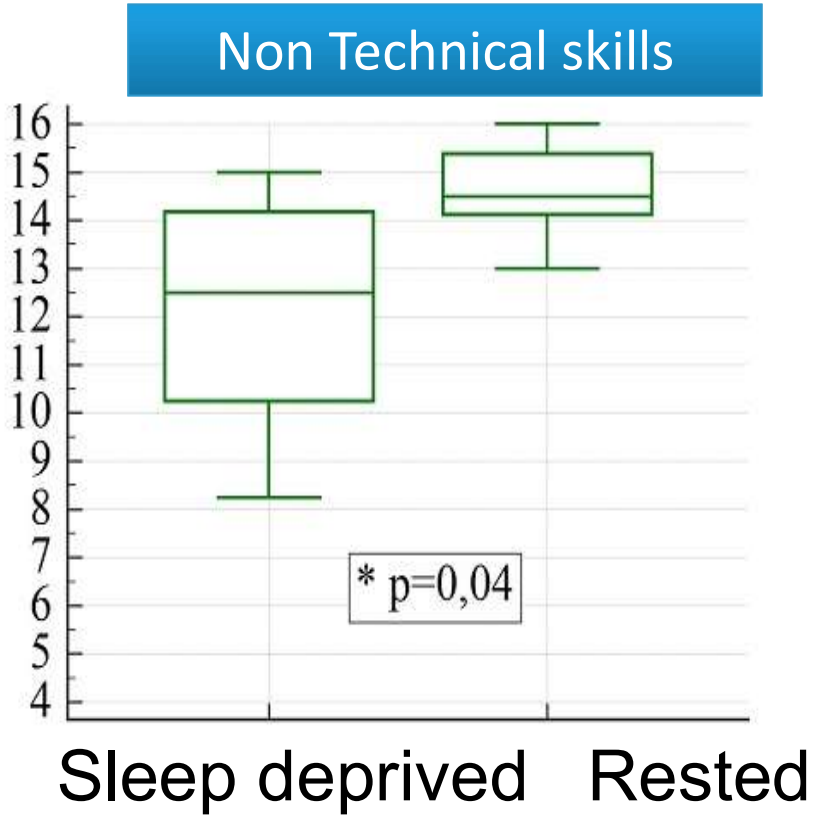
SLEEP DEPRIVATION AND RESIDENTS CONFIDENCE

- No significant differences for the trait of confidence
  - ⇒ Groups have equivalent level of general confidence before the simulation
- Residents under sleep deprivation reported a significant lower level of current confidence than rested residents



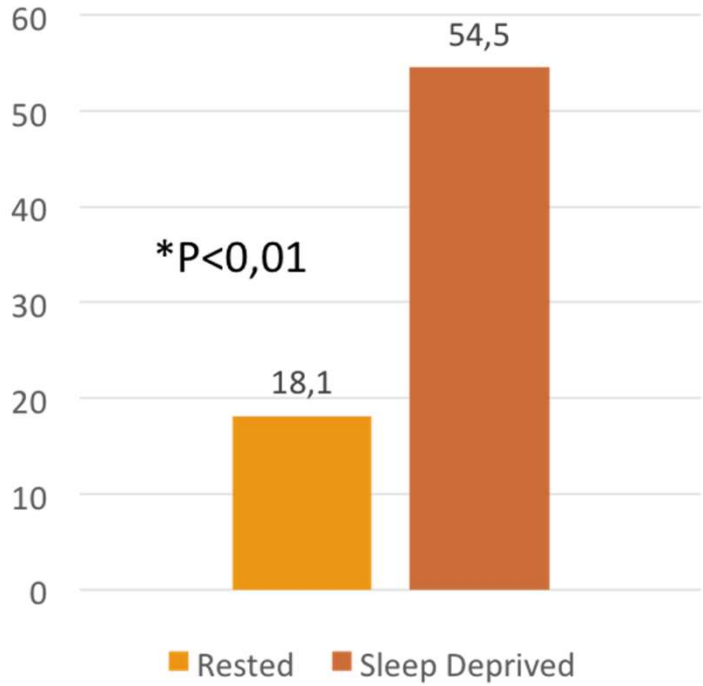
EFFECTS OF SLEEP DEPRIVATION ON RESIDENTS TECHNICAL AND NON-TECHNICAL SKILLS





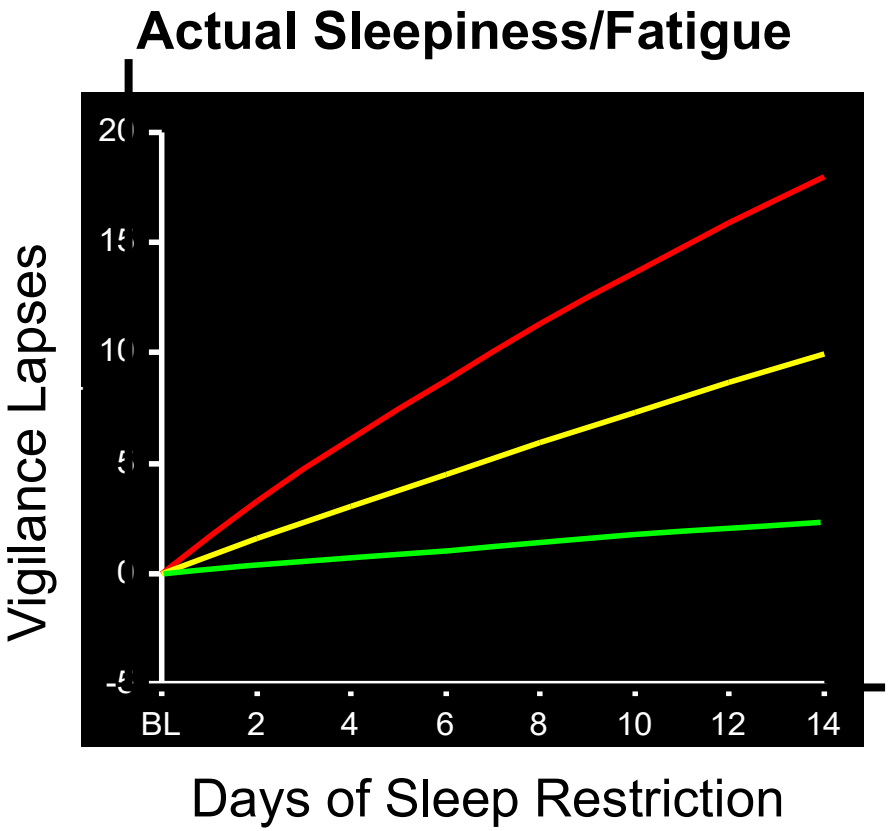
IMPACT OF SLEEP DEPRIVATION ON PERFORMANCE IN RESIDENT IN ANESTHESIA

- Sleep deprivation increases the frequency of initial decision changes under the pressure of authority
- Suggest a change in resident confidence and influence of authority



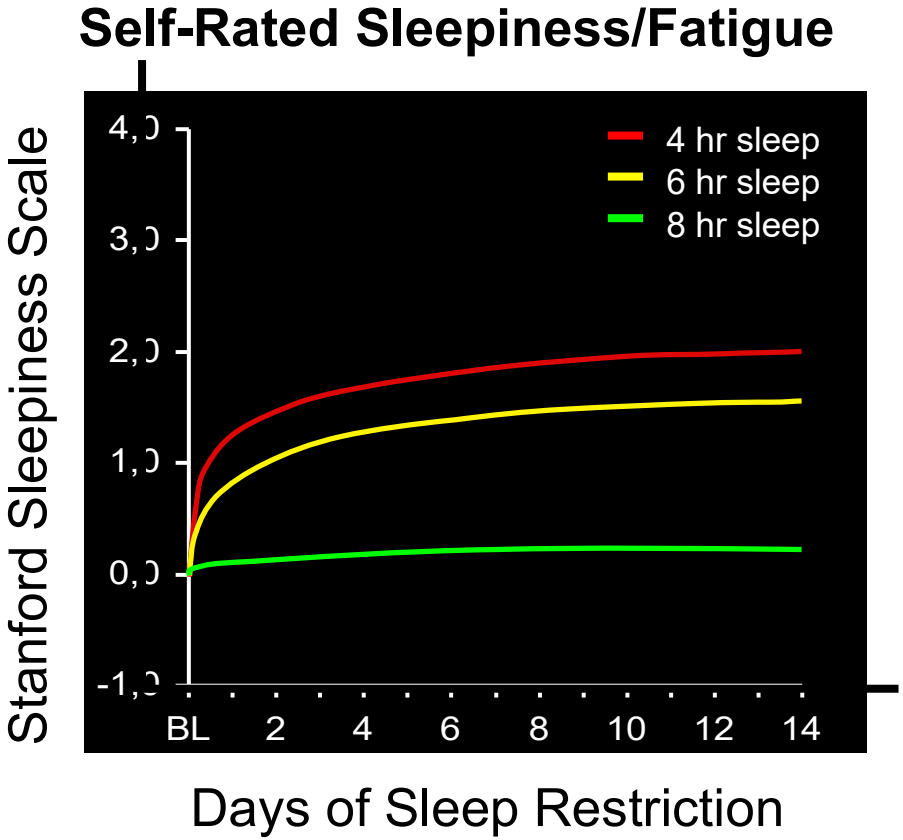
% of residents who changed their initial decisions

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)

MOST FREQUENT SLEEP DISORDERS

- **Insomnia**:
  - Difficulty falling asleep
  - Waking up often during the night and having trouble going back to sleep
  - Waking up too early in the morning
- **Obstructive Sleep Apnea Syndrome:**
  - Potentially serious sleep disorder
  - Occurs when a person's breathing is interrupted during sleep
  - Caused by a blockage of the airway
  - Symptoms : snoring, daytime sleepiness, fatigue, restlessness during sleep, gasping for air while sleeping and trouble concentrating
- **Restless legs syndrome:**
  - Causes an intense, often irresistible urge to move the legs
  - Symptoms: daytime sleepiness, irritability and concentration

DETECT A POTENTIAL SLEEP TROUBLE: THE EPWORTH

Situations	Points
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g. Theatre or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after lunch without alcohol	
In a car, whilst stopped for a few minutes in traffic	

How likely are you to doze off or fall asleep in thee situations:
Would never doze = 0 point
Slight chance of dozing=1 point
Moderate chance of dozing=2 points
High chance of dozing = 3 points

Total score meaning:
0-10 : normal
10-12 : borderline
12-24 : abnormal

CONTROLS SLEEP OPPORTUNITY

Level 1 controls are intended to make sure you get enough time off between shifts to get enough sleep

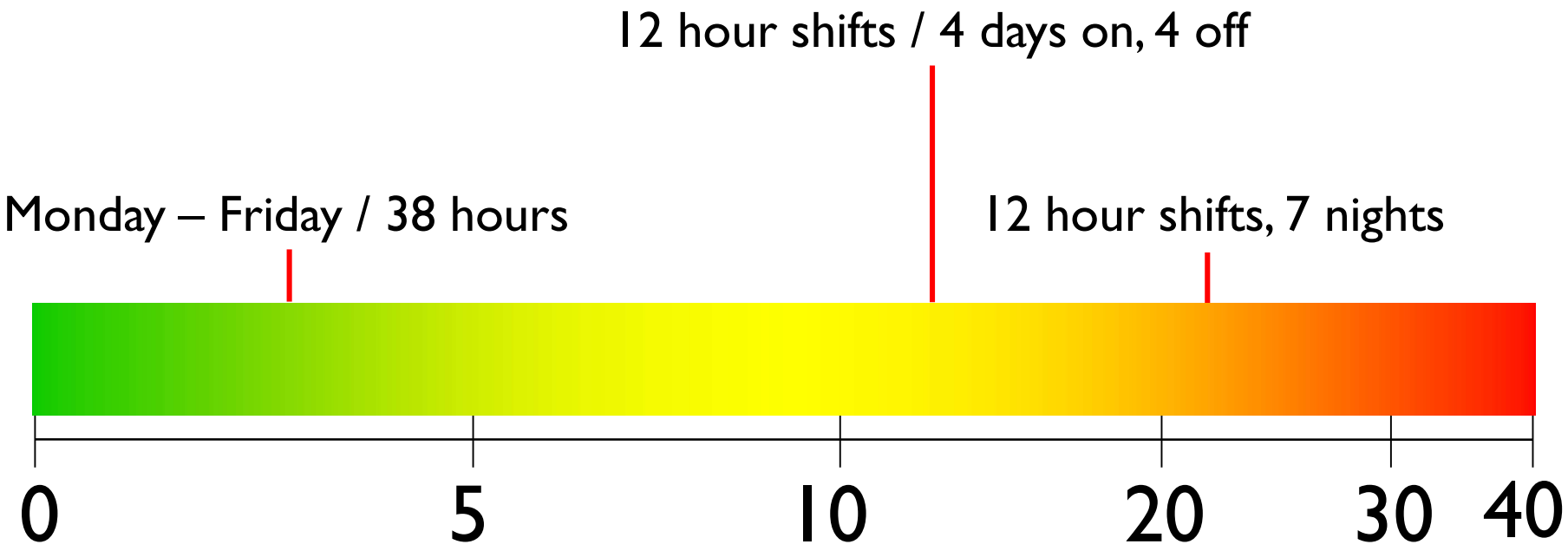
Schedules are evaluated according to:
- length and timing of shifts
- length and timing of breaks
- number of shifts worked in a row
- number of days off between shifts

A) Fatigue Likelihood Scoring Matrix for Work Schedules

	0 points	1 point	2 points	4 points	8 points
a) Total hours per 7 days	≤ 36 hours	36.1 – 43.9	44 – 47.9	48 – 54.9	55+
b) Maximum shift duration	≤ 8 hours	8.1 – 9.9	10 – 11.9	12 – 13.9	≥ 14
c) Minimum short break duration	≥ 16 hours	15.9 – 13	12.9 – 10	9.9 – 8	≤ 8
d) Maximum night work per 7 days	0 hours	0.1 – 8	8.1 – 16	16.1 – 24	≥ 24
e) Long break frequency	≥ 1 in 7 days	≤ 1 in 7 days	≤ 1 in 14 days	≤ 1 in 21 days	≤ 1 in 28 days

CONTROLS SLEEP OPPORTUNITY

B) Fatigue Likelihood Scores for work schedules



Score according to the Matrix of Work Schedules

INDIVIDUAL PREDICTIVE TOOLS

Individual Fatigue Likelihood Score "IFLS"

- A simple calculation can give you a fatigue likelihood score.

Prior sleep factor	Threshold value	Score
X (Sleep in prior 24 hours)	5 hours	Add 4 points for each hour below threshold
Y (Sleep in prior 48 hours)	12 hours	Add 2 points for each hour below threshold
Z (time awake since last sleep)	Y	Add 1 point for each hour of wakefulness greater than Y

INDIVIDUAL PREDICTIVE TOOLS

FATIGUE ASSESSMENT	SCORE
STEP 1: Sleep in prior 24 hours Sleep ≤ 2h 3h 4h 5+h Points 12 8 4 0	4
STEP 2: Sleep in prior 48 hours Sleep ≤ 8h 9h 10h 11h 12+h Points 8 6 4 2 0	2
STEP 3: Hours awake since last sleep (at the end of the shift) If sleep in Step 2 is greater than hours awake, points = 0. If less, add 1 point per hour awake greater than sleep in Step 2.	3
Total points to determine your score	9

WHAT FATIGUE LEVEL?	
SCORE	**CONTROL LEVEL**
1-4	**Fatigue risk: moderate**
5-8	**Fatigue risk: high**
9+	**Fatigue risk: very high**
Refer to the departmental fatigue risk management guidelines for approved controls	

IFLS Card

Individual Fatigue Likelihood Score

INDIVIDUAL PREDICTIVE TOOLS

Sample Decision Tree with IFLS

Score	Action
0	No action. Except in the presence of higher level indicators
1-4	Talk to supervisor and undertake approved individual countermeasures (i.e., self monitoring for symptoms, team monitoring by colleagues, task rotation)
5-10	File fatigue report with supervisor. Organize supervisory checks. Complete symptom checklist, task re-assignment
10+	File fatigue report with manager. Do not engage in risky behaviour. Do not start shift until fit for work.

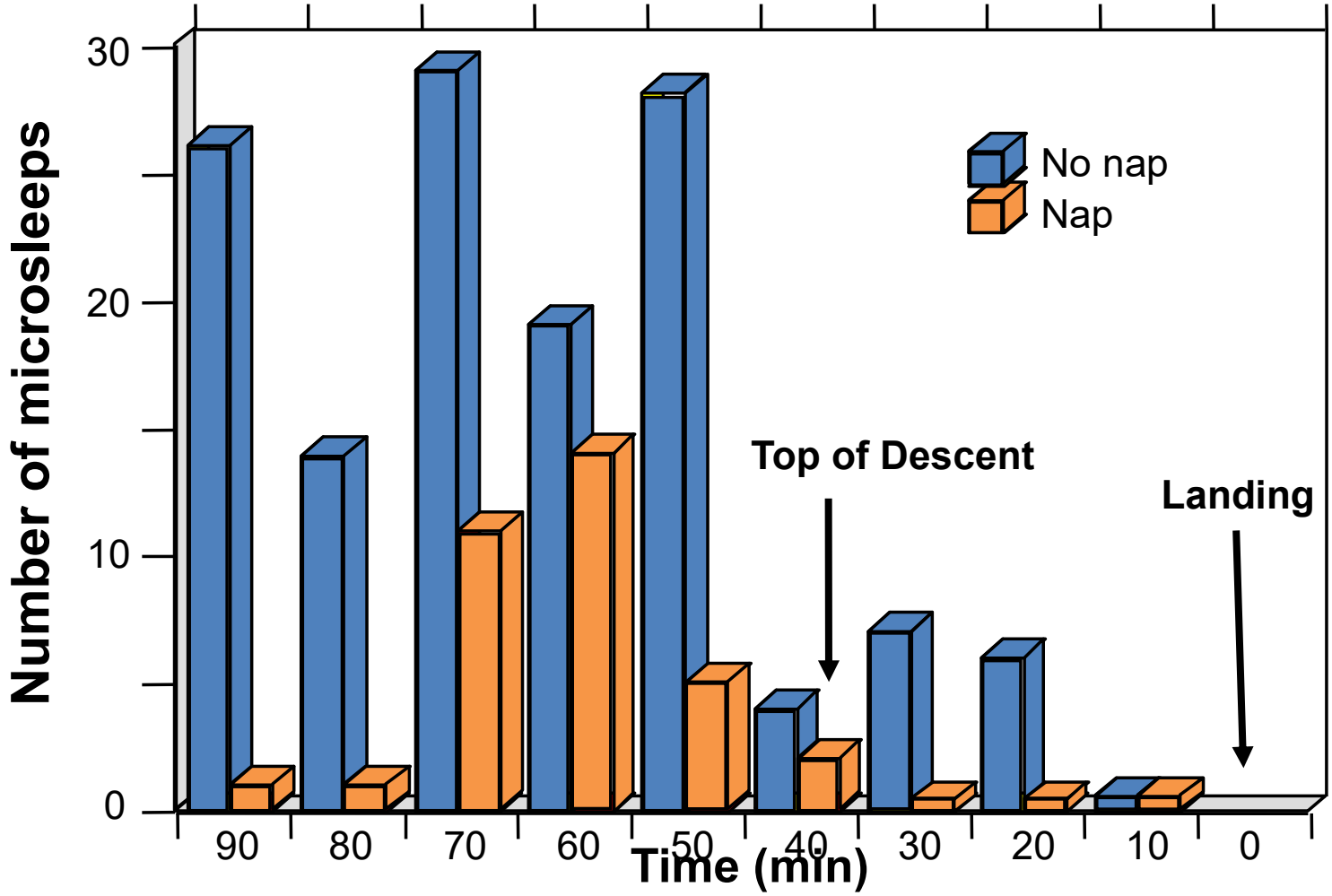
MANAGING FATIGUE
NAPPING

- 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,…)

RECUPERATIVE VALUES OF NAP

- Brief naps (less than 20 min) improve sleepiness and performance after both a restricted nocturnal sleep and a nocturnal sleep of normal duration
- A nap of 10 mn improves subjective and objective alertness, increase feelings of vigour and decrease fatigue, improve accuracy and speed on a number of cognitive tasks
- In case of sleep restriction or with normal nocturnal sleep duration, brief naps and long naps produce comparable benefits to alertness
- In case of total sleep deprivation, long naps have greater benefits than short naps

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."
- "The 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)

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!
-

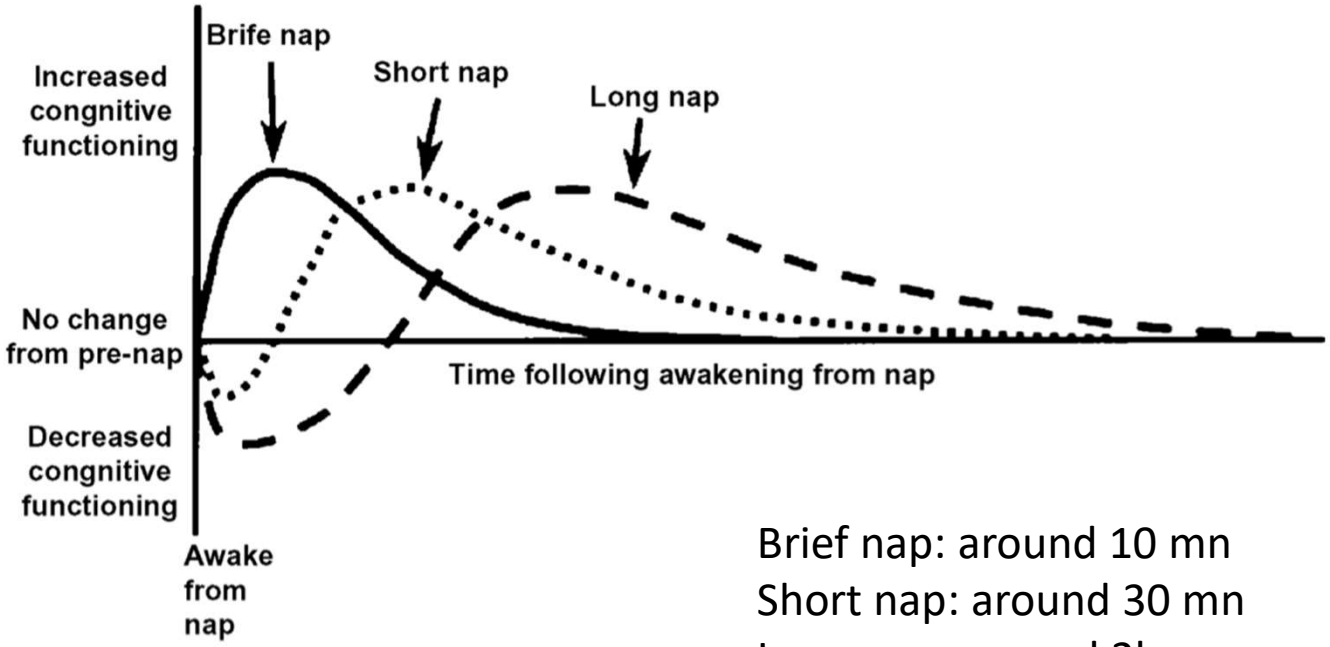
Effects of Power Nap:

Good alertness directly after awakening

Better memory recall after sleep

Reversing damages of sleep deprivation

HYPOTHETIZED BENEFITS/RISKS OF NAPS DEPENDING ON THEIR LENGTH



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

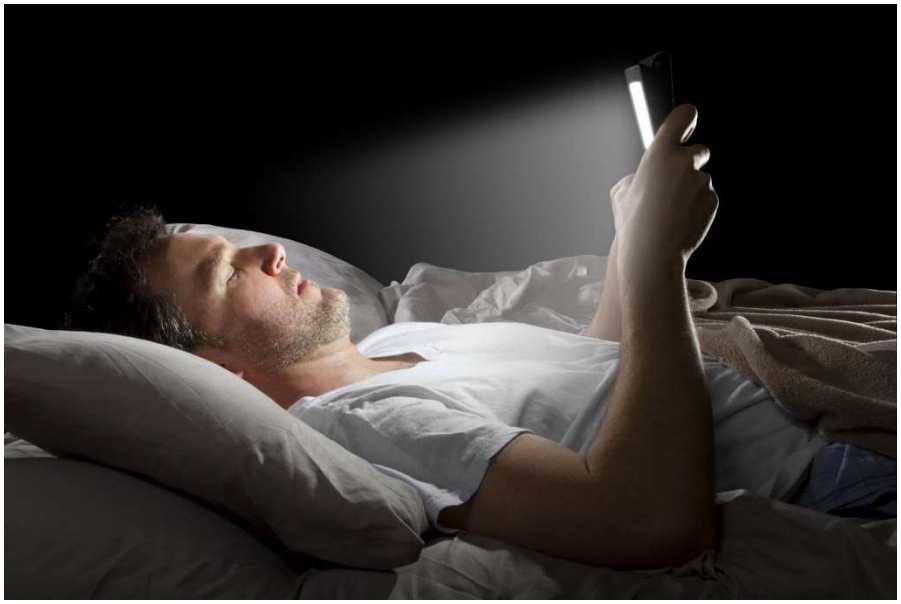
Lovato & Lack, 2010

PROTECT YOURSELF FROM BLUE LIGHT AT NIGHT

Even dim light can interfere with a person's circadian rhythm and melatonin secretion. A mere eight lux—a level of brightness exceeded by most table lamps and about twice that of a night light—has an effect

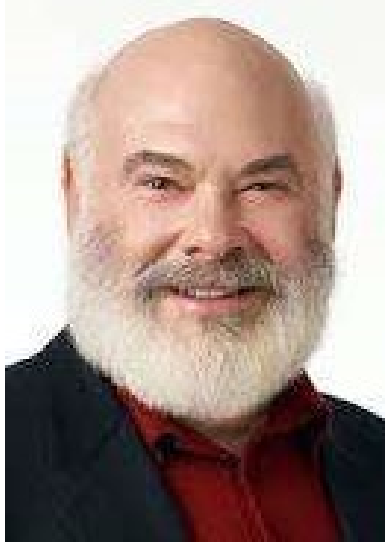
While light of any kind can suppress the secretion of melatonin, blue light at night does so more powerfully. The blue light suppressed melatonin for about twice as long as the green light and shifted circadian rhythms by twice as much (3 hours vs. 1.5 hours).

- Use dim red lights for night lights.
- Avoid looking at bright screens beginning two to three hours before bed.
- If you work a night shift or use a lot of electronic devices at night, consider wearing blue-blocking glasses
- Expose yourself to lots of bright light during the day, which will boost your ability to sleep at night, as well as your mood and alertness during daylight



FALLING ASLEEP : THE 4-7-8 BREATHING TECHNIQU

Andrew Weil, Pr at
Harvard University



- Exhale completely through your mouth, making a whoosh sound.
- Close your mouth and inhale quietly through your nose to a mental count of **four**.
- Hold your breath for a count of **seven**.
- Exhale completely through your mouth, making a whoosh sound to a count of **eight**.
- This is one breath. Now inhale again and repeat the cycle three more times for a total of four breaths
- Practice it every day
- Significant sleep improvement after 2-3 weeks

THE MILITARY METHOD (SHARON ACKERMAN)

1. Relax your entire face, including the muscles inside your mouth.
2. Drop your shoulders to release the tension and let your hands drop to the side of your body.
3. Exhale, relaxing your chest.
4. Relax your legs, thighs, and calves.
5. Clear your mind for 10 seconds by imagining a relaxing scene.
6. If this doesn't work, try saying the words "don't think" over and over for 10 seconds.
7. Within 10 seconds, you should fall asleep!

AMOUNT OF CAFFEINE IN VARIOUS DRINKS

Type of drink	Size	Caffeine (mg)
Coffee brewed	237	95-200
Coffee brewed, decaf	237	2-12
Espresso	30	47-75
Espresso, decaf	30	0-15
Instant coffee	237	27-173
Instant, decaf coffee	237	2-12
Black tea	237	14-70
Black tea, decaf	237	0-12

AMOUNT OF CAFFEINE IN VARIOUS DRINKS

Type of drink	Size	Caffeine (mg)
Green tea	237	24-45
Iced tea	237	11-47
Coca-Cola	355	23-35
Dr Pepper	355	36-42
Red Bull	248	75-80

MAIN EFFECTS OF CAFFEINE

- Takes around 30 min after intake to have an effect,
- The effects may last for 5 hours after intake
- Can be used as a short-term strategy only
- Avoid taking caffeine when already alert. Use it to increase the effect when alertness is low
- 150-250 mg of caffeine has a significant effect of alertness and performance
- Increases sleep latency and impairs sleep quality
- Large inter-individual differences in the sensitivity to caffeine

ENERGY DRINKS

Side effects:

- Palpitations / tachycardia
- Tremor / shaking
- Agitation / restlessness
- Gastrointestinal upset
- Chest pain / ischaemia
- Dizziness / syncope
- Paraesthesia (tingling or numbing of the skin)
- Insomnia
- Respiratory distress
- Headache

To be used with care !

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

BIOLOGY OF STRESS

LAZARUS (1968) – PSYCHOLOGICAL APPRAISAL

Situation

Primary appraisal

Is this a threat ? A challenge ?

Perceived threat

Secondary appraisal

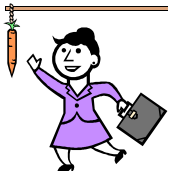
What control do I have ?

No coping

Stress

Coping

Stimulation



No perceived threat

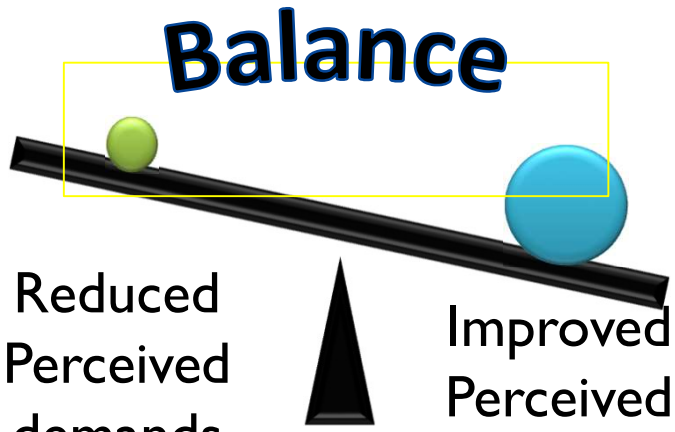
No stress

Re-evaluation

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

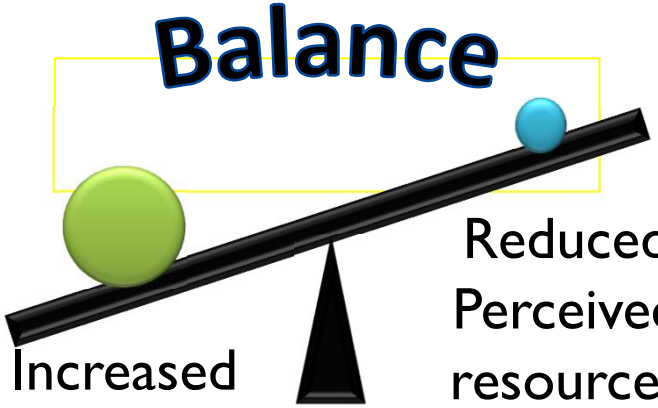
What is improving perceived resources is also reducing perceived demands:

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:

Stress

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

ACUTE STRESS AND MEMORY

- **Focus on “here and now”**
- Impairment of long-term memory and prospective memory (what you are planning to do in the next coming minutes)
- Cognitive fixation with a reduced available time to access knowledge and procedure

ACUTE STRESS AND PERFORMANCE

- **Shock** : shift from automatic actions to controlled actions, costly in resources and time. Shift from implicit memory (witout awareness) to explicit memory (with awareness)
  =>Delay in action, " paralysis by analysis"
- **Panic** : back to instinctive responses, oriented towards survival, impaired short term memory

  => Freeze or instinctive responses

ACUTE STRESS AND PERFORMANCE

- **Confirmation bias**

  =>> searching the same information to confirm the pre-selected hypotheses

- Do not challenge the action plan and to revise the selected solutions

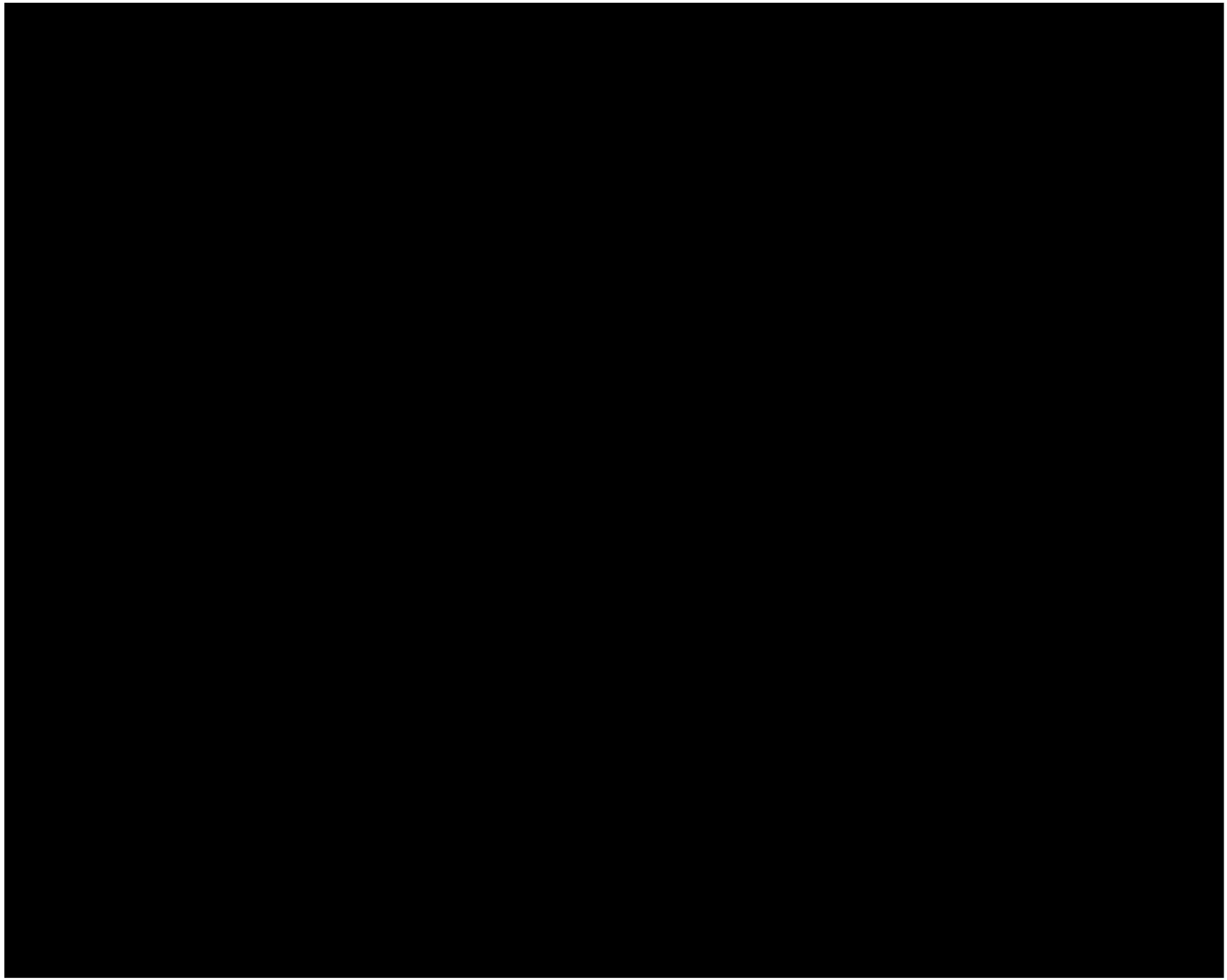
ACCIDENT EXAMPLES

- Air Asiana, San Francisco, July 6 2013
  - The trainee pilot flying was "stressed about the approach to the unfamiliar airport and thought the autothrottle was working before the jet came in too low and too slow »

- Air France Rio Paris, June 1 2009
  - Inappropriate response" from stressed pilots

HUMAN ERRORS & VIOLATIONS

MOVIE: BRITISH MIDLAND



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…

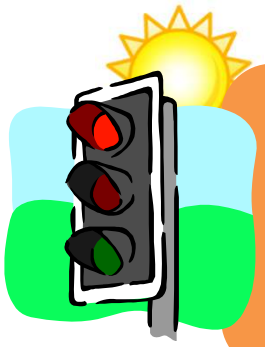
- I am not complying with a rule, a procedure a standard

By definition, there is no intention in error

- We can't decide to not committing error

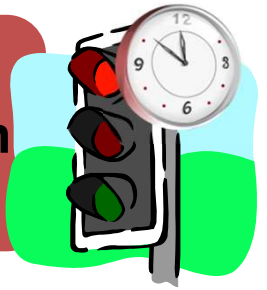
Violation is a voluntary act

- Most frequent reason: « do the job»



I have the sun in the eyes, I ran the redlight, I did not see it

I see a high speed car coming behind me I ran the redlight



WHY ARE THEY DOING THAT?

They are mad?

They are running out of time?

System failure?

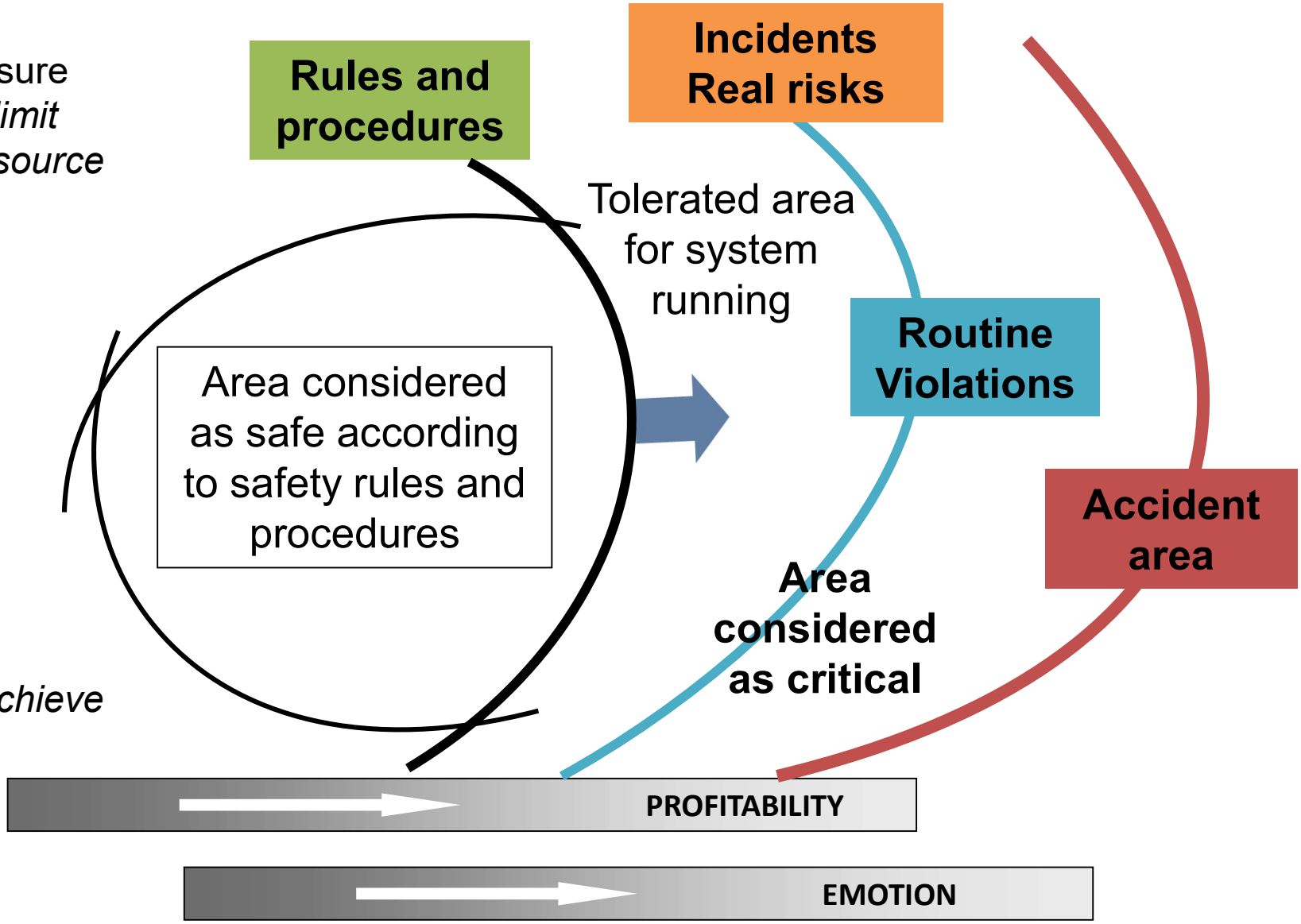
The willingness to do the job…

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

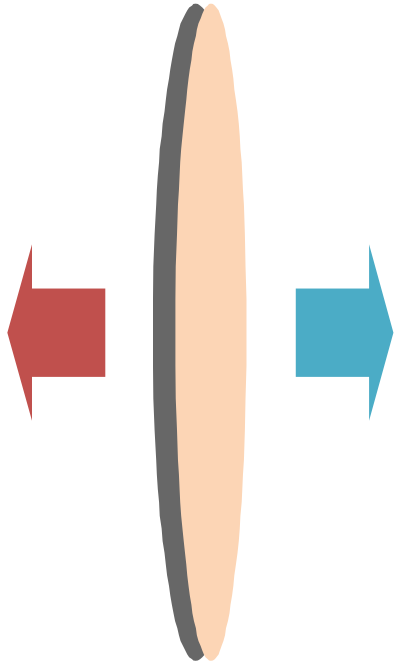


« ERROR IS HUMAN! »

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

It means:

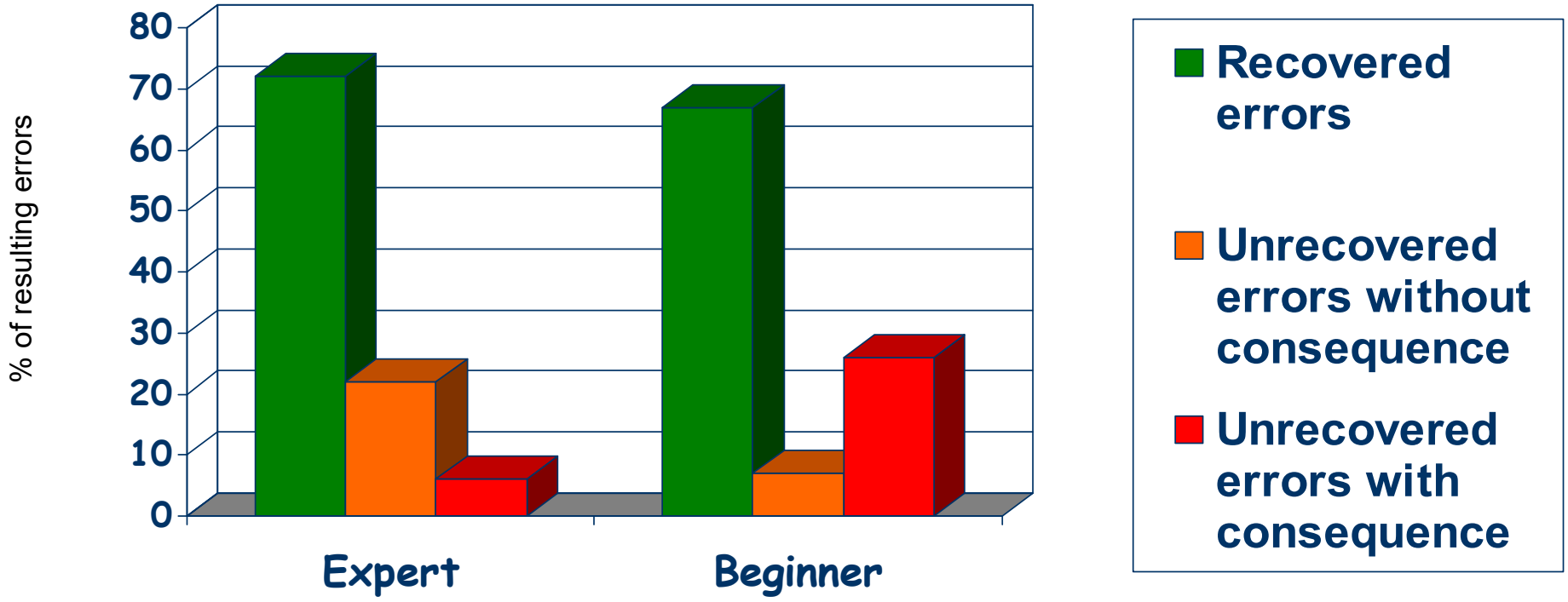
(1) : Everybody do error



(2) : We use error to adjust our performance

ERRORS AND RISK MANAGEMENT

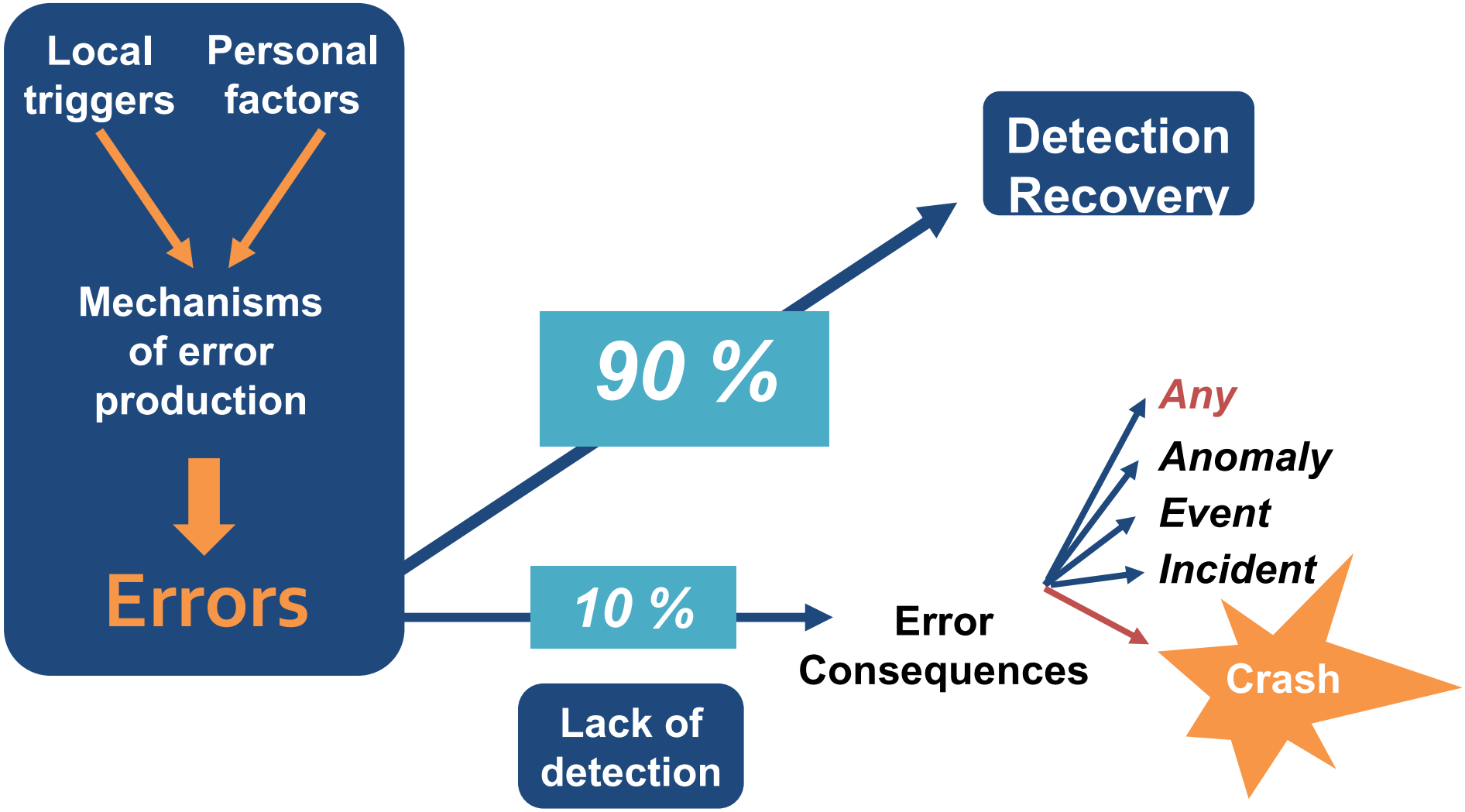
- Errors are inevitable (line pilots make approx. 2 errors every hour!)
- Managing their consequences is crucial!



Source : Amalberti, 1998

THERE IS NO LINK BETWEEN ERROR AND THEIR CONSEQUENCE

ERROR DETECTION AND RECOVERY



PREVENTING ERRORS…

- Use of the associated working documents
- Preparation, anticipation, planning
- Organising the work space
  - Differential storage of tools, parts, labels
  - Use of personal reminders, post-its, etc…
- Mutual supervision and assistance
- Training: reliable personal routines
- Design of technical systems
- Checklists
- …

DETECTING ERRORS BY...

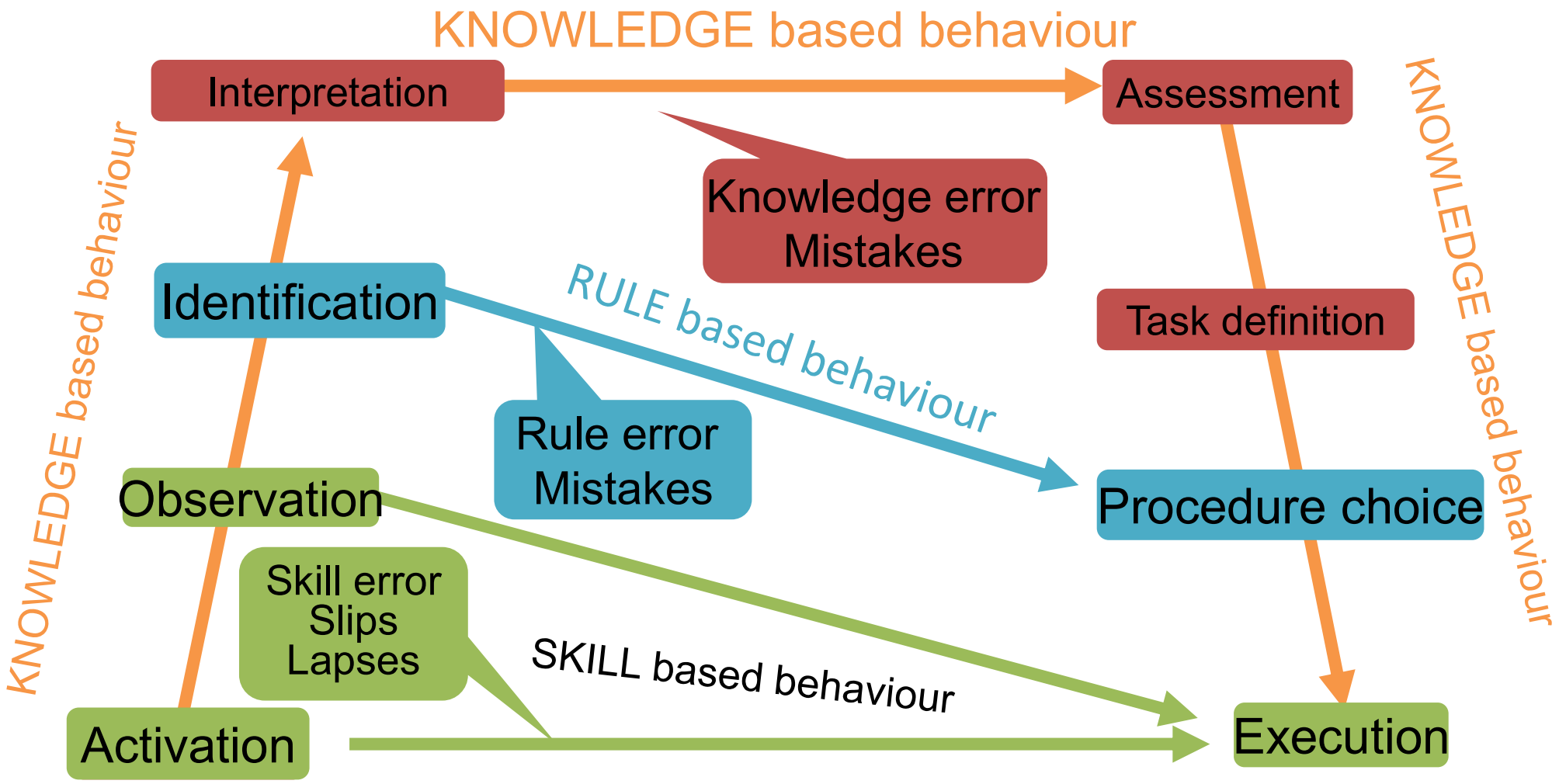
- Self-checking
  - Common operations checking
  - Systematic operations checking
  - Raising the question
  - Observing the outcome of the action
- Detection by others
  - Mandatory checks
  - Cross-checks
  - Take note of your colleagues
- Abnormal cues (technical: noise, indication, operation…)

DETECTION… A FEW BASIC CONDITIONS

- What are the conditions for a self-check to be effective and useful?
  - Time
  - Doubt enough
  - Knowing about your possibility of error

- What are the conditions for a cross-check to be effective and useful?
  - Accept the possibility of making errors,
  - Do not diminuish the one who made the error (don't call him stupid of that!)
  - Show mutual respect

ACTIVITY CONTROL: SRK MODEL (RASMUSSEN) FROM DISCOVERY TO ROUTINES



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

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

The behavior is adjusted:

- Increase of margin
- Increase of attention

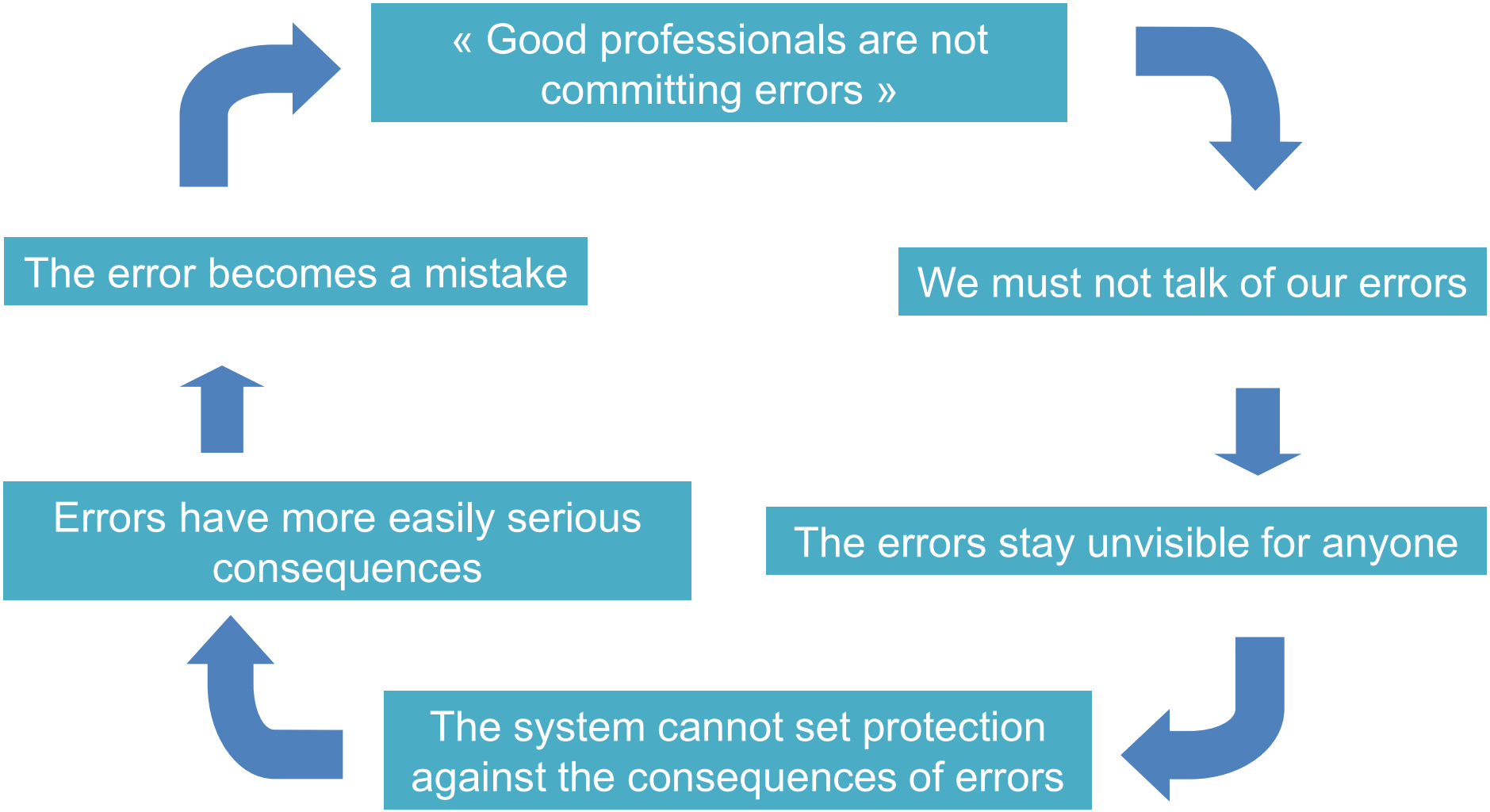
Learning and adaptation

THE NEW CHALLENGE: MANAGE THE CONSEQUENCES

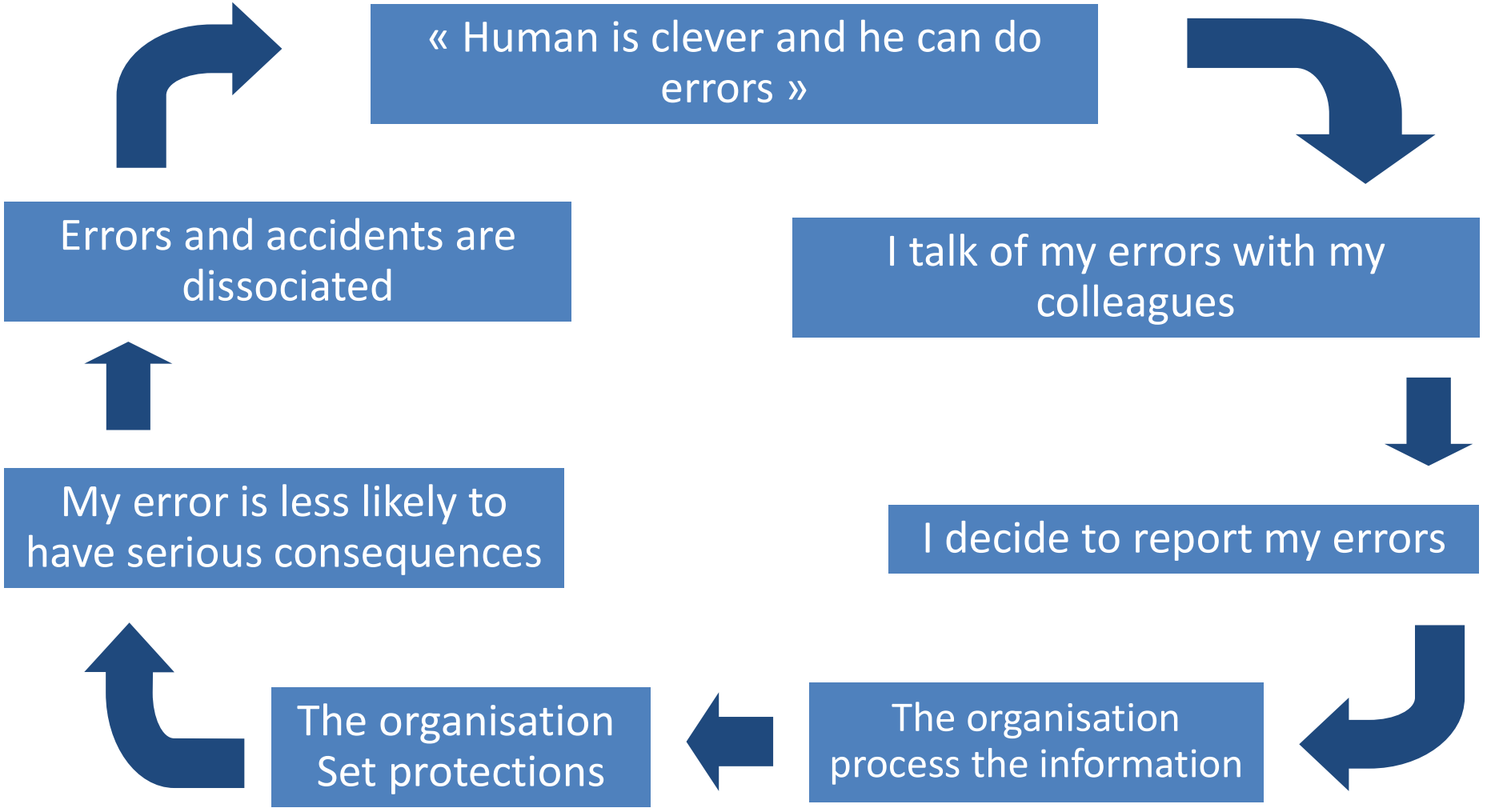
- Error is natural and cannot be avoided
- No link between error and their consequences
- What is needed is to manage the consequences

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



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)

PSYCHOSOCIAL FACTORS

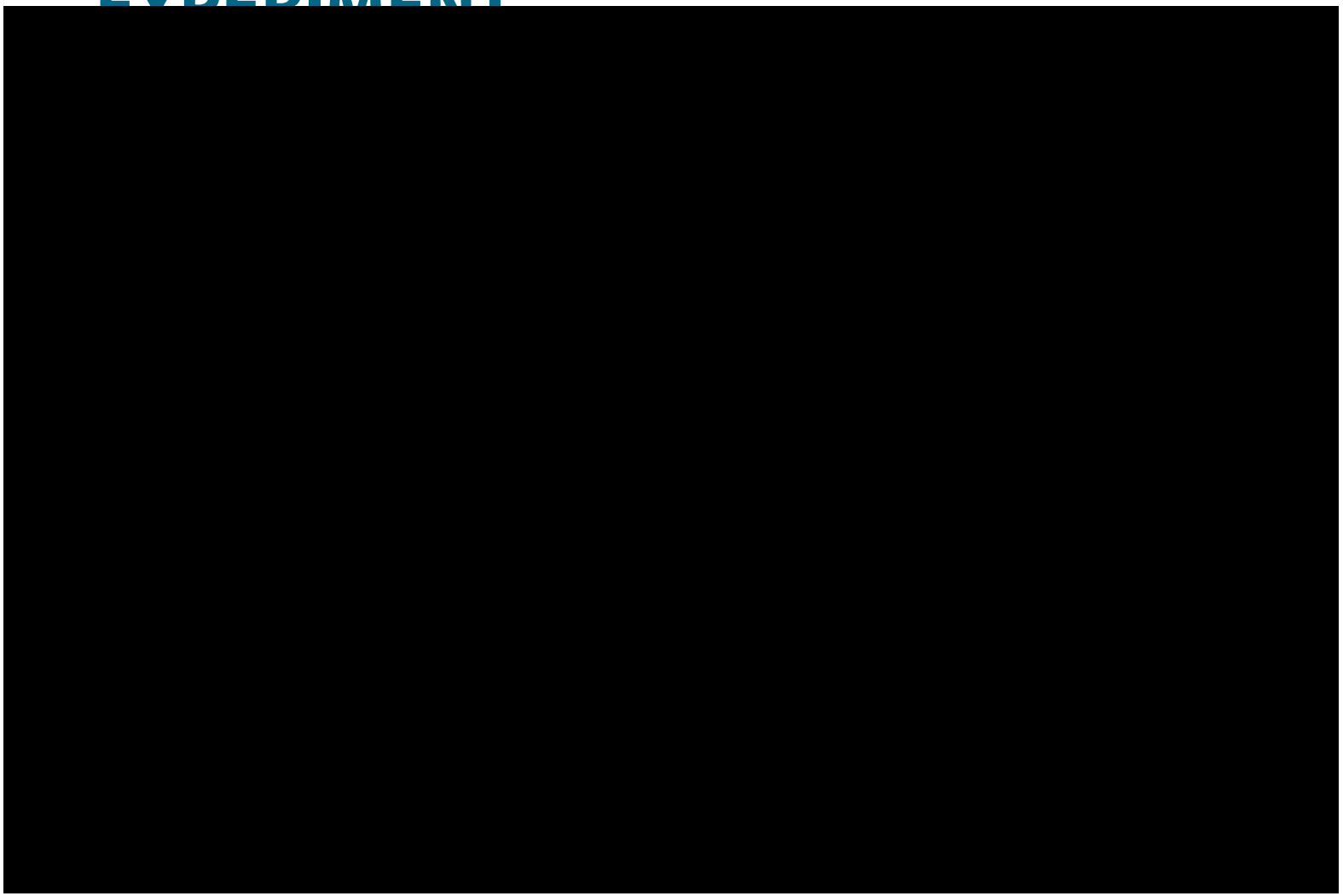
DEFINITIONS AND SCOPE OF SOCIAL PSYCHOLOGY

- 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, communication, leadership

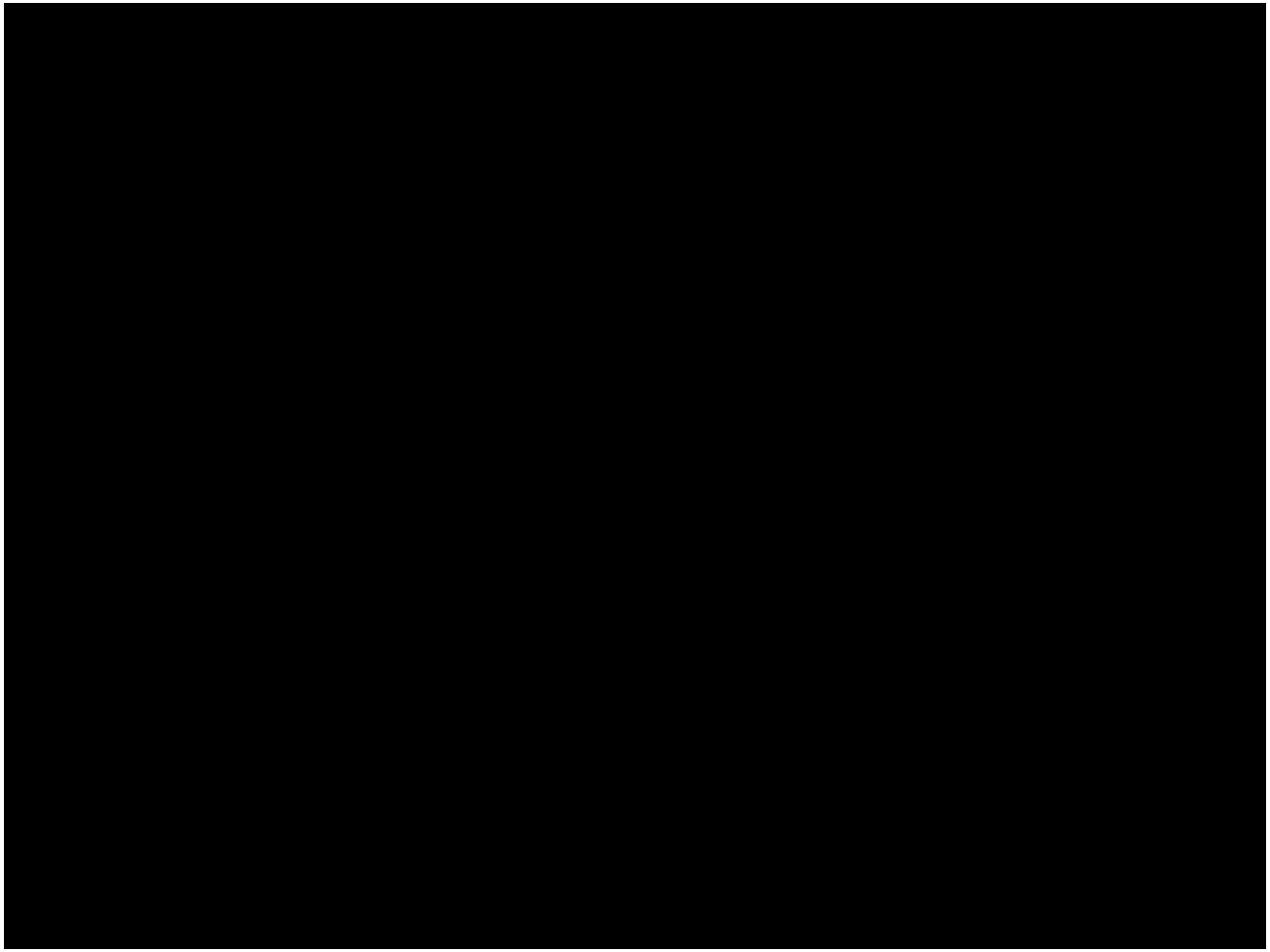
MILGRAM EXPERIMENT ON OBEDIENCE

- 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)

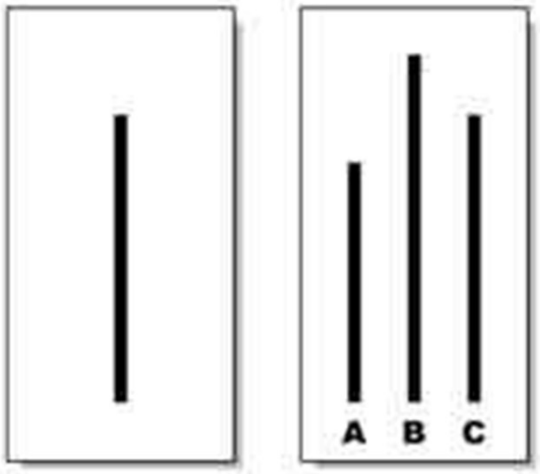
MILGRAM EXPERIMENT



CONFORMITY EXPERIMENT



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

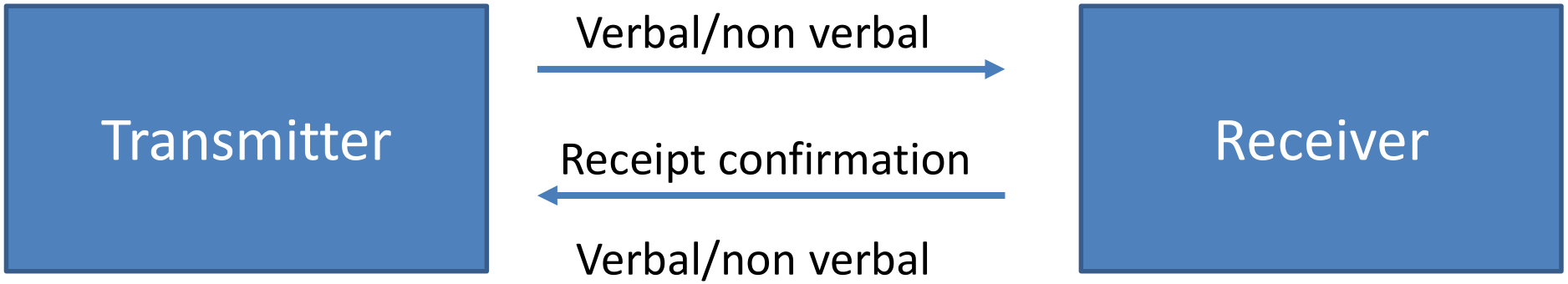
- When we explain the behavior of others we look for enduring **internal attributions**, such as personality traits: fundamental attribution error.

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

STEREOTYPES

- A fixed, over generalized belief about a particular group or class of people
- Advantage : enables us to respond rapidly to situations because we may have had a similar experience before
- Drawback : makes us ignore differences between individuals; therefore we think things about people that might not be true (i.e. make generalizations)

COMMUNICATION



- A good communication requires to share a common context
- Receipt confirmation reduces the risk of errors

FIVE IMPORTANT ASPECTS OF COMMUNICATION

- Advocacy
- Listening
- Inquiry
- Critiques
- Conflict resolution

ADVOCACY

- Refers to the need to state what you know or believe in a direct manner
- Lack of advocacy has contributed to United Airlines accident in Portland and Air Florida accident in Washington

UNITED AIRLINES 173, 28 DECEMBER 1978, PORTLAND

- *The National Transportation Safety Board determined that the probable cause of the accident was the failure of the captain to monitor properly the aircraft's fuel state and to properly respond to the low fuel state and the crew-member's advisories regarding fuel state. This resulted in fuel exhaustion to all engine's. His inattention resulted from preoccupation with a landing gear malfunction and preparations for a possible landing emergency.*
- *Contributing to the accident was the failure of the other two flight crewmembers either to fully comprehend the criticality of the fuel state or to successfully communicate their concern to the captain."*

LISTENING

- Requires more than passive attention
- Requires the listener to be more open, actively inquire through questions and respond appropriately
- Always accept that what the transmitter said may be be true

INQUIRY

- Act of asking for information or act of investigation
- In the cockpit information comes from the visual scan of the flight instruments and questioning other crew members or ATC
- Egos aircrew are often reluctant to ask for clarification
- The captain did not ask more clarification from the copilot in Air Florida accident in Washington

CRITIQUE

- Critique is necessary because it helps to improve our cognitive and interpersonal skills
- All crew members should know to expect a critique
- Try to reduce embarrassment while giving a critique
- The critique should consist of frank discussion among the crewmembers
- The attitude and reaction of the person receiving the critique may be just as important as the person giving the critique

CONFLICT RESOLUTION

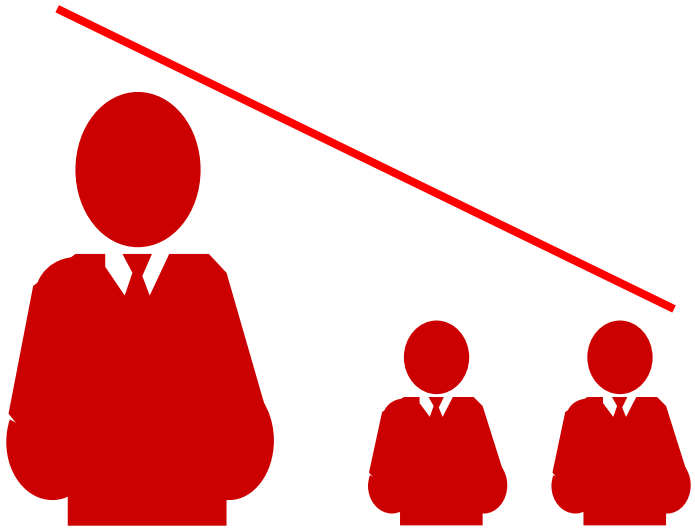
- Conflict means a serious disagreement of argument
- May have serious effect on decision making quality
- Conflict can bring positive effects it is well managed: leads to deeper thinking, creative new ideas, respect each other
- The proper way to resolve the conflicts is to:
  - Have a policy of crew coordination that is known and accepted by everyone
  - Bring out all issues of disagreement.

AUTHORITY & LEADERSHIP

- Authority gradient
- … the difference in authority between the team leader and the other team members
- Not only actual authority, but the leader's *perceived* and *agreed* power

STEEP AUTHORITY GRADIENT

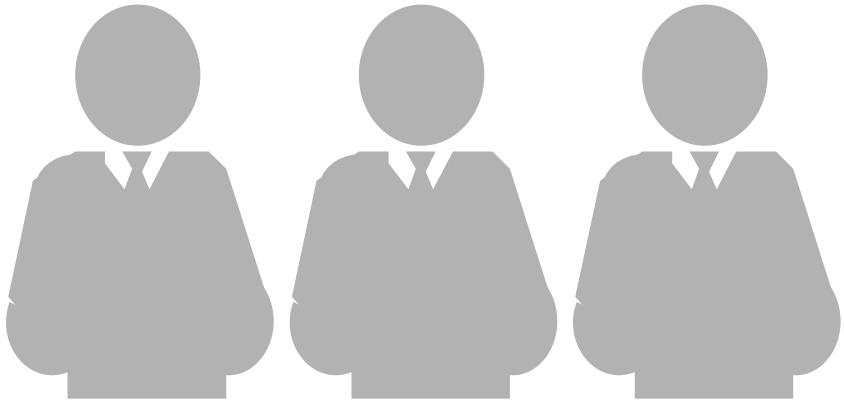
- The leader is clearly in charge
- Tells others what to do
- Doesn't encourage the team to contribute



- Advantages?
- Disadvantages?
- Risks?

FLAT AUTHORITY GRADIENT

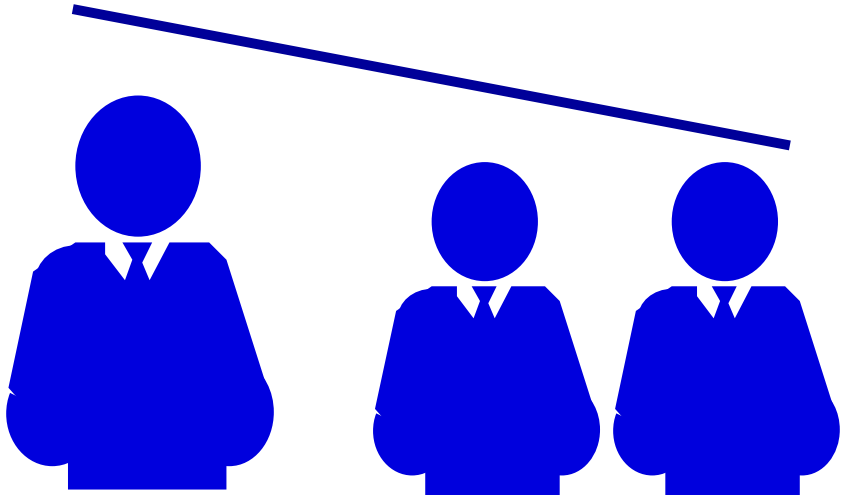
- The leader is “one of the boys”
- Shows little leadership
- Lets the team do what they want



- Advantages?
- Disadvantages?
- Risks?

IDEAL AUTHORITY GRADIENT

- … for normal work situations
- Gradient is not flat but not too steep
- Leader is in charge, but consults team, asks them to contribute ideas etc



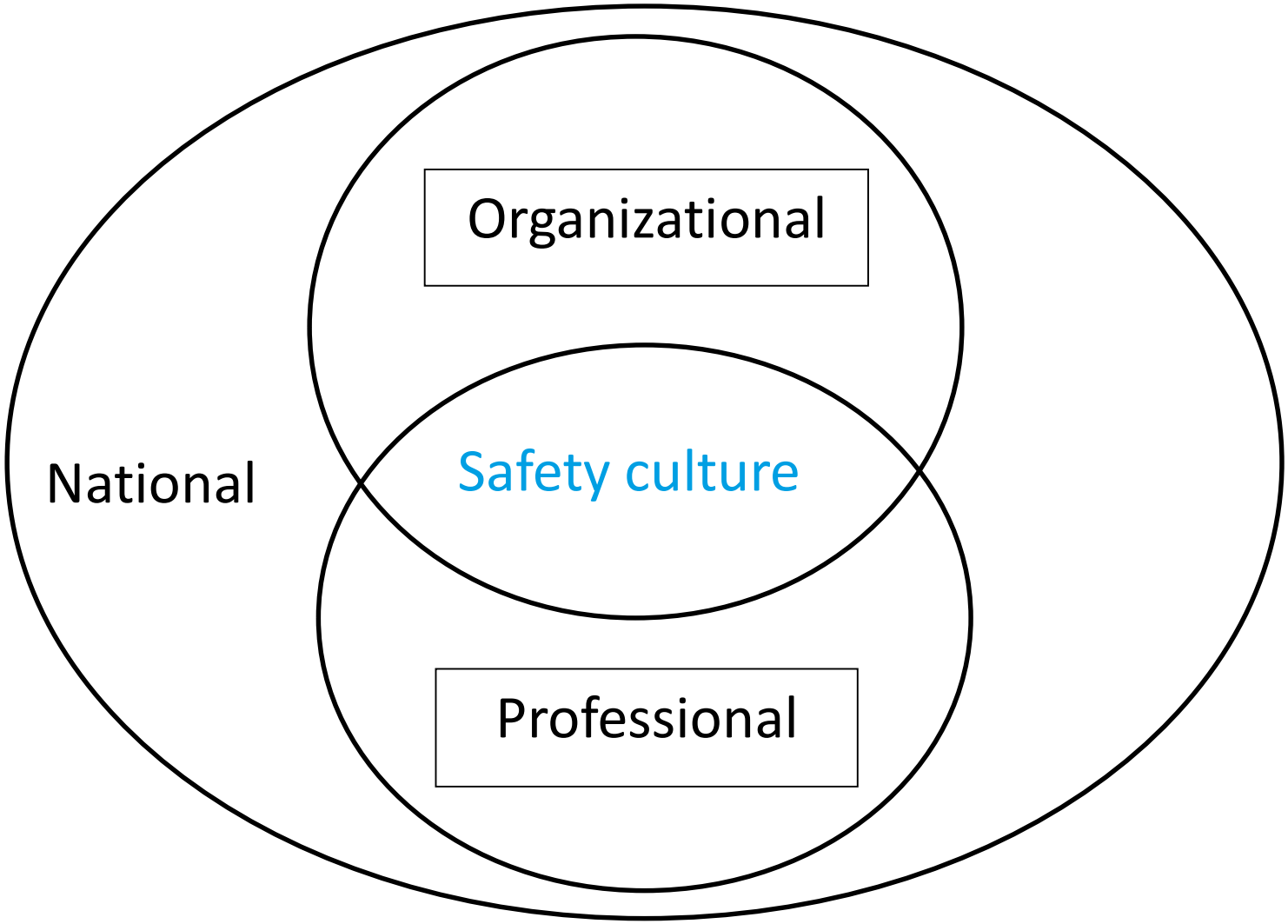
SAFETY CULTURE

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, wilful violations and destructive acts **are not tolerated**

SAFETY CULTURE



SOME ASPECTS OF NATIONAL CULTURE

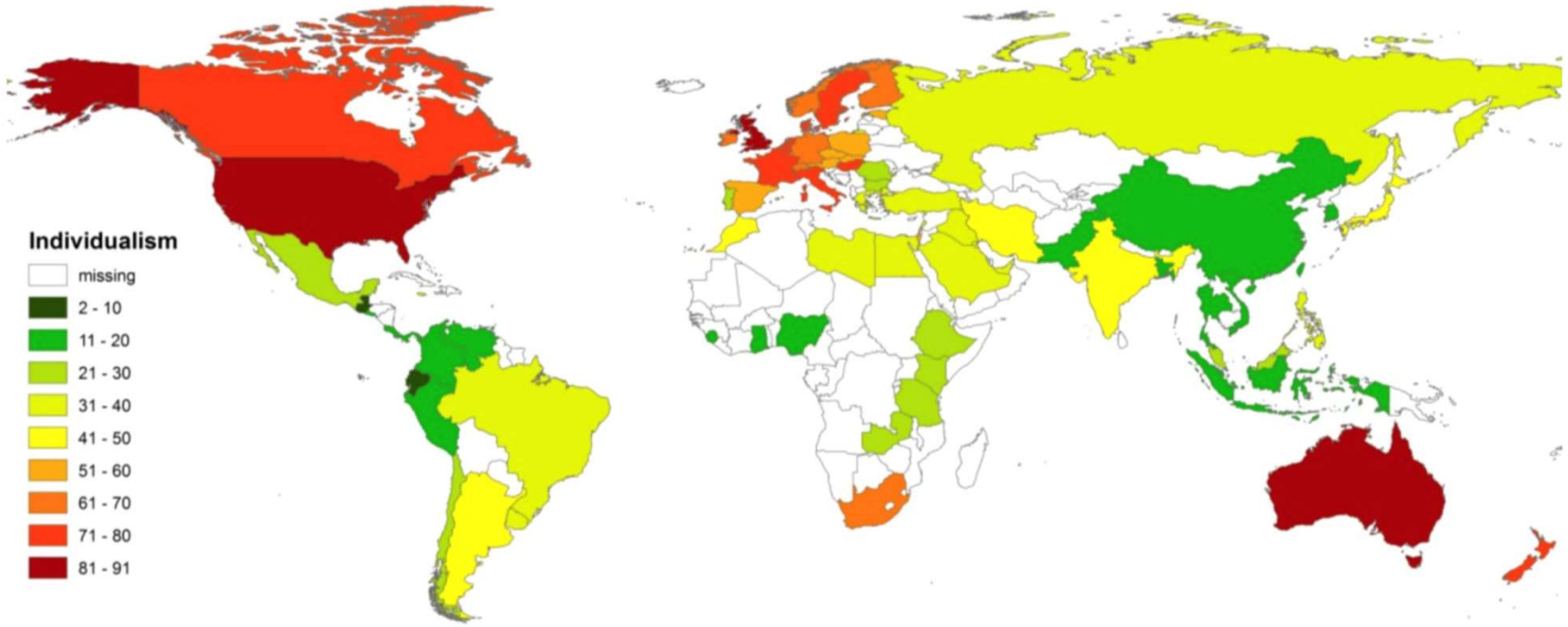
Individualism

- value ***in***dependence
- promote personal ideals, strengths, and goals
- pursued in competition with others
- leading to individual achievement and finding

Collectivism

- value ***inter****dependence*
- promote group and societal goals and duties,
- blending in with group identity,
- achievement attributed to mutual support

MEASURE OF INDIVIDUALISM

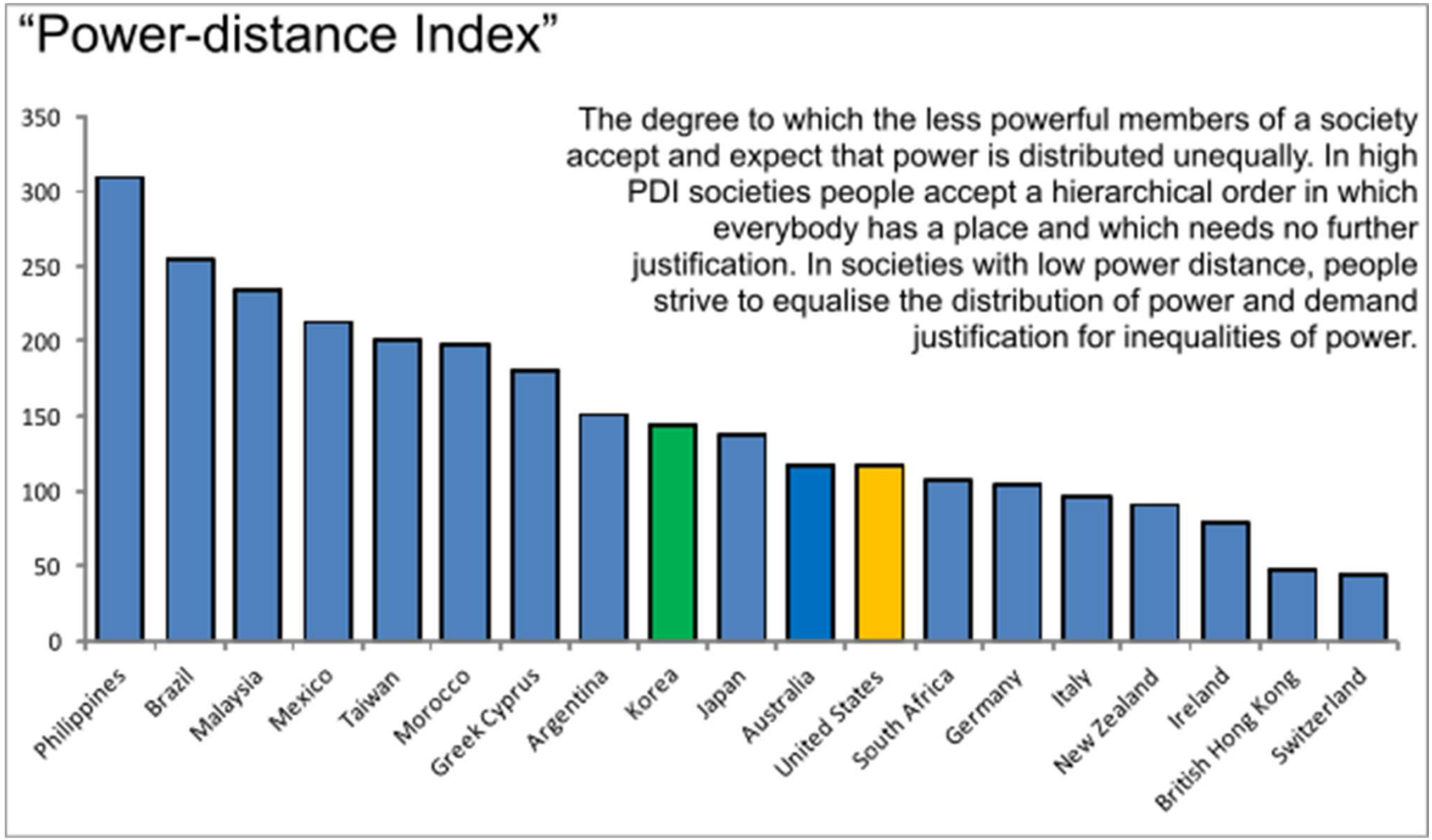


« THIS WAS A DISASTER 'MADE IN JAPAN' »

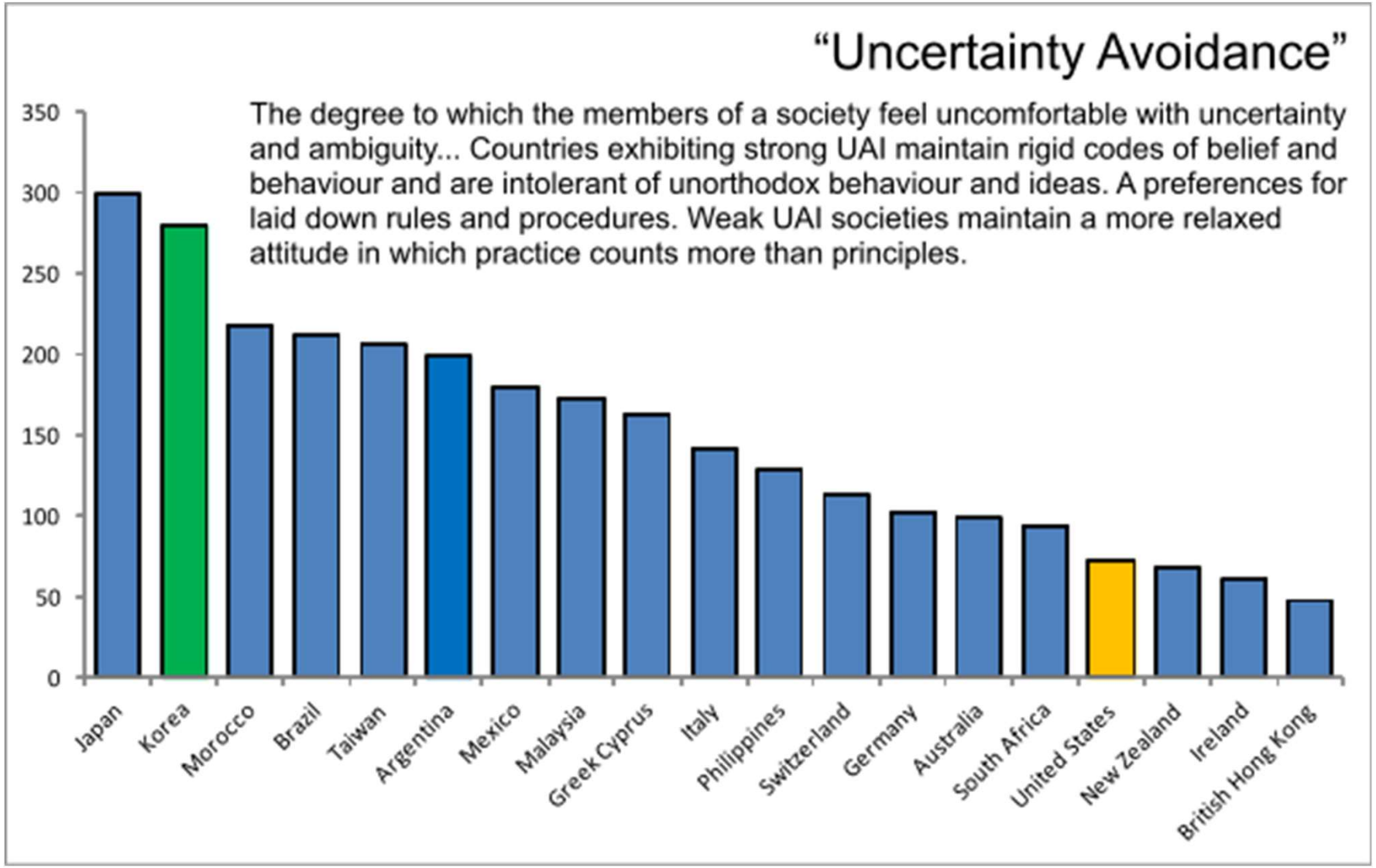
Fukushima Nuclear Accident Independent Investigation Commission

« 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



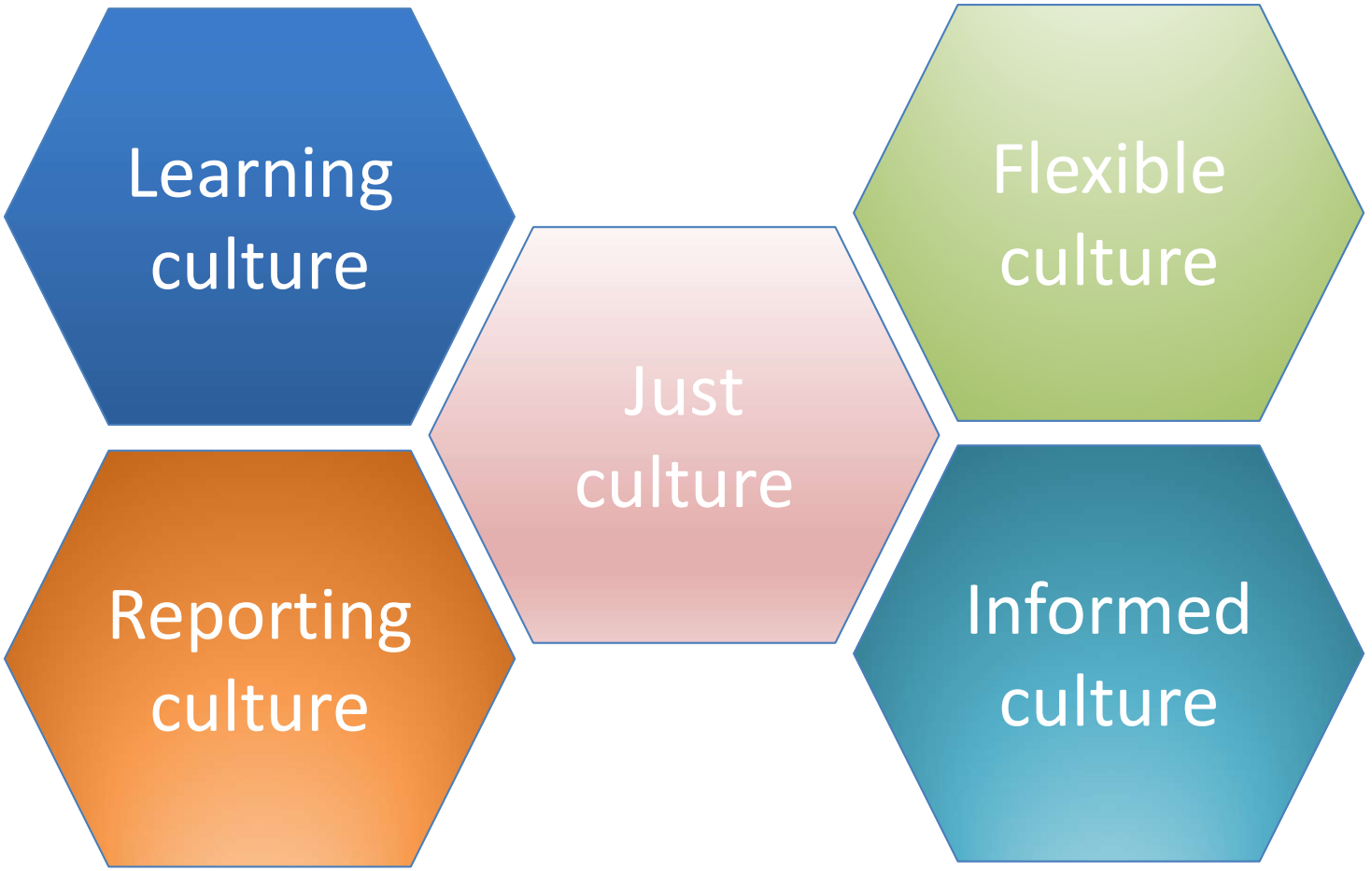
ORGANISATIONAL CULTURE (R. WESTRUM)

Pathological (power oriented)	Bureaucratic (rule oriented)	Generative (performance-oriented)
Low cooperation	Modest cooperation	High cooperation
Messengers shot	Messengers neglected	Messengers trained
Responsabilities shirked	Narrow responsabilities	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

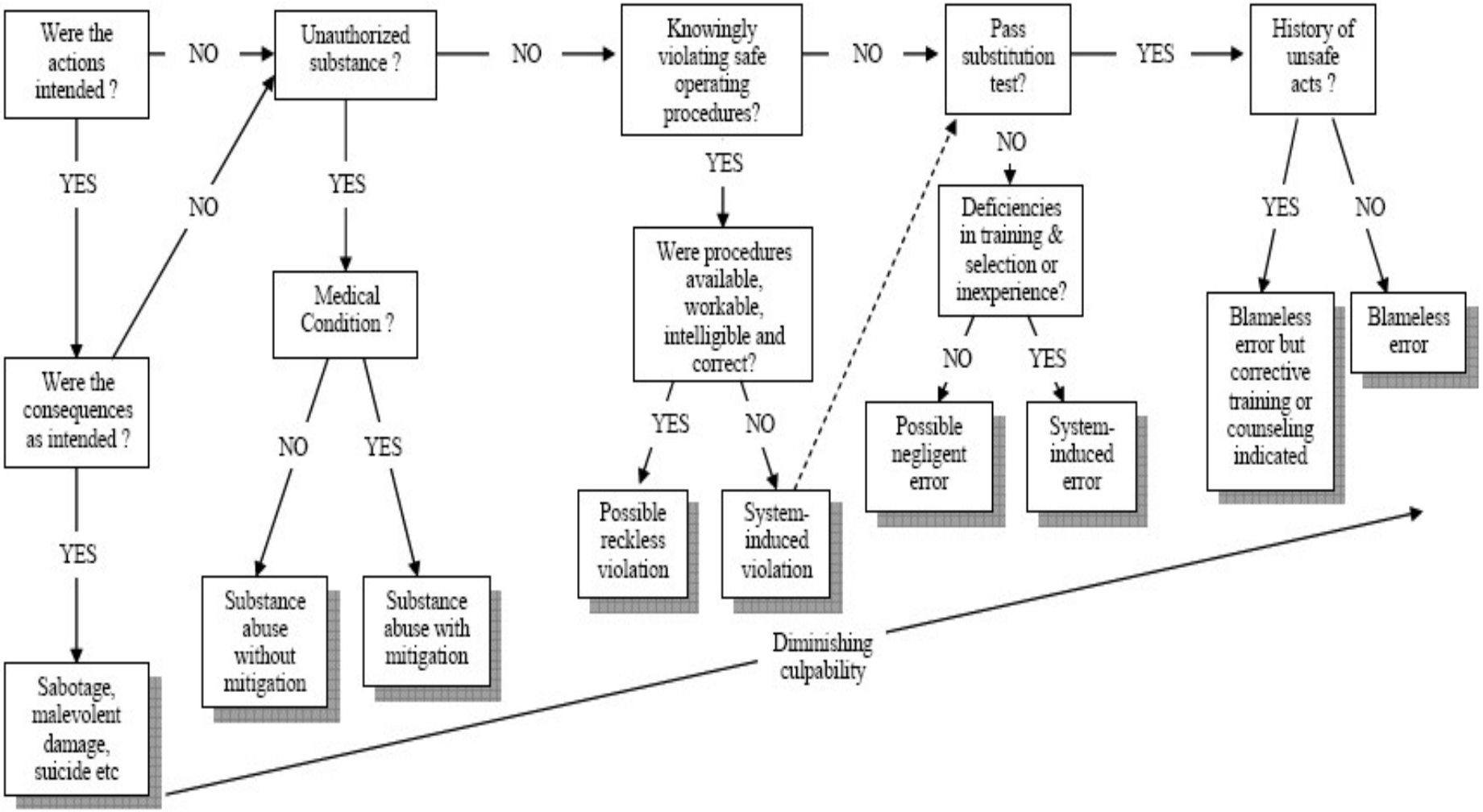
PROMOTING A POSITIVE SAFETY CULTURE

- 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 individual behaviours

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".

Safety culture cases (2/6)

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 (4/6)

Case n° 5 – Auto-throttle connection

The aircraft was on final approach. The left radio altimeter was defect and the crew was aware of this. They had decided that the approach would be flown on the right autopilot, probably assuming this would isolate the aircraft from the faulty left radio-altimeter. The crew did not understand that the auto-throttle system is always connected to the left radio altimeter, even when the right auto-flight system is selected. As such, the aircraft was tracking the ILS nicely, however the auto-throttle had closed the throttles to idle ('RETARD FLARE'). The crew may have noticed this, however because the aircraft was vectored quite close to the runway, the aircraft initially had been above the glide slope and had to lose speed and altitude at the same time, requiring much less thrust. The closed throttles did probably not present an unusual state to the pilots. However, the aircraft continued to lose speed and finally stalled at about 500 ft and could not be recovered.

Safety culture cases (5/6)

Case n° 6 – 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° 7 – 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° 8 – 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° 9 – 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
9				X