



OCCUPATIONAL PSYCHOLOGY

Human Error

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BUT – TO ERR IS HUMAN..

- Human errors occur all the time, but they don't always lead to accidents
- Human errors are assumed to contribute to up to 90% of incidents and accidents
 - Paddington Rail Crash
 - Southall Rail Crash
 - Herald of Free Enterprise Disaster

Is human error the fault of the individual or the systems and organisational culture in which they operate??



WHAT IS AN ERROR?

- The failure of planned actions to achieve their intended outcome
 - Or an unintended action, or undesirable one
- A deviation between what was actually done and what should have been done
- Not random events – usually caused by a combination of events and/or multiple variables
- An action that violates one or more system tolerance limits (and such limits can vary between systems)

WHAT IS AN ERROR?

When demands exceed capabilities

Capabilities
of people



Demands
of the job

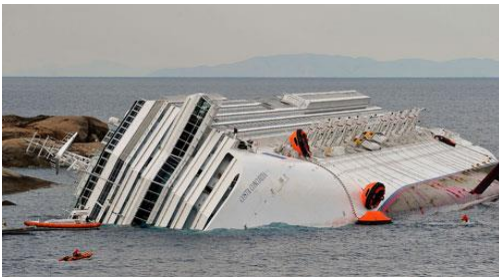
What happens?

- Fatigue (physical and mental)
- Musculoskeletal disorders (MSDs)
- Human error

ERROR DETECTION CAN BE DIFFICULT

- Attitudes
 - "They're only human"
 - "People make mistakes"
 - "You can't make it idiot proof"
- Mini-errors are usually corrected
- Near misses are not always reported
- Trends are difficult to see

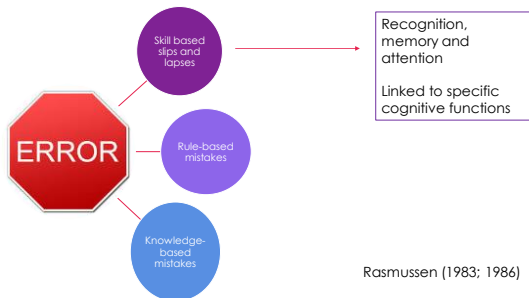
HUMAN ERROR: COSTA CONCORDIA



THE COSTA CONCORDIA DISASTER

- Captain had deviated from the ship's computer programmed route to treat people on a nearby island to the spectacle of a close sail-past
- Passengers told at first that the problem was a reparable 'electrical fault' and told maritime officials that the event was merely a 'black out'
- Captain delayed preparations to abandon ship
- Captain left ship during eventual evacuation and did not re-board despite orders by maritime officials
- Captain arrested on preliminary charges of multiple manslaughter in connection with causing a shipwreck, failing to assist 300 passengers, and failing to be the last to leave the wreck. Also charged with failing to describe the scope of the disaster and with abandoning incapacitated passengers.

THREE BASIC ERROR TYPES



1. SKILL-BASED SLIPS AND LAPSES

- Skill-based behaviour is related to sensory-motor performance
 - Guided by intentions
 - Minimal control of conscious attention
 - Happens in many cases where actions have become automated

1. SKILL-BASED SLIPS AND LAPSES

- Slip = 'failure of response execution'
- Lapse = 'failure of memory'
- Both can be made inadvertently by experienced workers during routine tasks

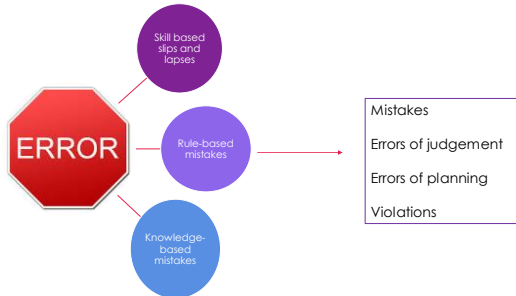
1. SKILL-BASED SLIPS AND LAPSES

- Three main failures:
 - Recognition failures
 - Memory failures
 - Attention failures
- Each can be linked to specific cognitive functions
 - Perception, divided attention, prospective memory, automatic processing

E.G.,. ERRORS DURING THE PERCEPTION STAGE

- Failure to perceive (see, hear feel) or detect something (a stimulus or signal)
- Failure to understand what was perceived
- Failure to perceive it on time
- Incorrectly identifying incoming signal
- Perceiving something that isn't there

THREE BASIC ERROR TYPES



2. RULE-BASED MISTAKES

- Rule-based behaviour is guided by rules and procedures that are either stored in memory or made available through explicit instructions/protocols
- Can happen in many circumstances
 - E.g.,
 - Misapplying a good rule
 - Applying a bad rule
 - Failing to apply a good rule

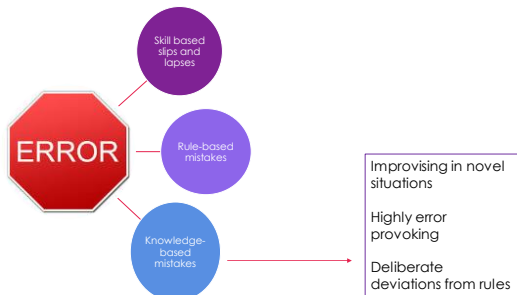
2. RULE-BASED MISTAKES

- Misapplying a good rule
 - Inappropriate circumstances
 - Potential misunderstanding of procedure/protocols
- Applying a bad rule
 - Comes with unwanted consequences
 - Potential misunderstanding of the situation and the plan of action for dealing with it
- Failing to apply a good rule
 - Misunderstanding or lack of training?
 - Violation / non-compliance of procedures

2. RULE-BASED MISTAKES

- Mistakes are often decisions found to be wrong after the fact, even though the individual believed them to be correct at the time
- Mistakes can also occur where a worker is doing too many complex tasks at the same time, or is under time pressure
 - E.g., if a driver is attempting to overtake and misjudges the time and space needed to complete the manoeuvre

THREE BASIC ERROR TYPES



KNOWLEDGE-BASED ERRORS

- Occur when people have to improvise in novel situations
- Deliberate deviations from rules, potentially for safe operation of equipment
- Although deliberate, tend to stem from a desire to perform work satisfactorily given particular constraints and expectations



KNOWLEDGE-BASED ERRORS

- Don't fall into convenient categories, however, they do show the influence of various biases:

1. CONFIRMATION BIAS

- People form hunches very quickly
- But, once established, these early hypotheses are resistant to change, even when contradictory evidence is available



KNOWLEDGE-BASED ERRORS

- Don't fall into convenient categories, however, they do show the influence of various biases:

2. OVER-CONFIDENCE

- People generally tend to be over-confident in evaluating the correctness of their knowledge
- Tend to justify a violation by focusing on evidence that favours the choice made, and disregarding contradictory signs



KNOWLEDGE-BASED ERRORS

- Don't fall into convenient categories, however, they do show the influence of various biases:

3. OUT-OF-SIGHT-OUT-OF-MIND

- Factors that are not immediately evident to problem-solvers tend to be neglected
- Also give undue weight to those factors that spring readily to mind



KNOWLEDGE-BASED ERRORS

- Don't fall into convenient categories, however, they do show the influence of various biases:

4. HALO EFFECT

- When faced with a complex judgement, people tend to focus on one dominant factor, and then make all other characteristics of the situation conform to this judgement, even when it is wrong



TYPES OF VIOLATION

- **Routine**
 - We've never worn hard hats before
- **Situational**
 - I normally wear a hard hat but it would make access to this area difficult
- **Exceptional**
 - I should get my hard hat but I need to reach this panel quickly and it will only take a moment
- **Optimising**
 - Hard hats are not really necessary for this task and I can get it done more quickly this way



CAUSES OF VIOLATIONS

- Lack of safety culture
- Incorrect knowledge of consequences
- Poor morale
- Violation-condoning norms
- Inappropriate or ambiguous rules/instructions
- Macho attitudes
- Pressure
 - Workload
 - Perceived management expectations
 - Time
 - Output

FACTORS CONTRIBUTING TO HUMAN ERROR - VIOLATIONS

- **Job**
 - Distractions; lack of time; inadequate procedures; poor lighting; extremes of temperature
- **Human**
 - Physical ability; competency; fatigue; stress; drugs
- **Organisational**
 - Work pressure; long hours; insufficient supervision
- **Equipment**
 - Poor equipment design; workplace layout

PERCEPTIONS OF VIOLATIONS

- I improvise
- You bend the rules
- They violate procedures

WHAT CAN CAUSE ERRORS?

- We make errors when we are...

tired, distracted, hungry, thirsty, inexperienced, overly experienced, too young, too old, middle-aged, addle-brained, over weight, under weight, resourceful, forgetful, hurried, impatient, good-humoured and ill, not wanting to kill, lingering, feverish, recovering, well intentioned, expert, novice, looking, seeing, calculating, cerebrating, estimating, guesstimating, under pressure, in a rut, in a hurry, in the dark, not believing, not accepting, flustered, cool, frightened, calm, hopeful, listening, and not hearing the bell.



TWO APPROACHES TO HUMAN FALLIBILITY...





1. PERSON APPROACH

- Longstanding tradition of this approach focuses on the unsafe acts (e.g., procedural violations) of people at the 'sharp' end: nurses, surgeons, anaesthetists, etc.
- Focuses on the errors of individuals, blaming them for forgetfulness, inattention, poor motivation, carelessness, or moral weakness
- Countermeasures include campaigns appealing to people's sense of fear in organisations
 - Threat of litigation, retraining, naming and blaming, and shaming



1. PERSON APPROACH

- Errors = moral issues
- Bad things happen to bad people – Just World Hypothesis
- Blaming individuals is emotionally more satisfying than blaming an institution/organisation
- Effective risk management depends crucially on establishing a reporting culture



1. PERSON APPROACH

We cannot change the human condition, but we can change the conditions under which humans work



2. SYSTEMS APPROACH

- Basic premise = human are fallible and errors are to be expected...
 - Even in the best organisations
- Concentrates on the conditions under which individuals work and tries to build up defences to avert errors, or mitigate the effects



HOW CAN WE
REDUCE HUMAN
ERROR?





ORGANISATIONAL CULTURE

- Effective training / re-training programmes
- Effective recruitment and selection strategies
- Good working practices (working hours etc)
- Good leadership
- Enhancing motivation, commitment, and morale



SYSTEMS DESIGN

- Importance of designing systems that minimise the chance of an employees error resulting in serious consequences
- Particularly in automated industries
 - E.g., nuclear industry



ORGANISATIONAL SAFETY CULTURE

- Effective leadership on health and safety
- Employee involvement in health and safety
- Investigations of near misses
 - Not just incidents/accidents
- Team responsibility for error reporting
- Not disciplining staff for reporting errors
 - Promoting reporting culture



HUMAN RELIABILITY ASSESSMENT

- First step in carrying out a Human Reliability Assessment
 - Work out what can go wrong
 - To do this, you have to understand the task
- The role of task analysis:
 - Understanding, in advance of errors, how people really complete tasks...
 - And hopefully pre-empt such errors



HUMAN ERROR AND FATIGUE



CAUSES OF FATIGUE

- Workload
- Working environment
- Shiftwork
- Overtime
- On call working
- Travel time
- Recovery time



FATIGUE

- Fatigue has been implicated in 20% of accidents on major roads
- Fatigue costs the UK £115-240 million per year in terms of work accidents alone



FATIGUED PEOPLE ARE...

- More prone to:
 - Error, poor decision-making, memory lapses
 - Working more slowly and less efficiently
 - Drowsiness (e.g. can include micro-sleeps)
- And, are less:
 - Alert, receptive, responsive
 - Able to detect change
 - Able to sustain concentration

INCREASED RISK OF INCIDENTS/ACCIDENTS



FATIGUE

- Acute fatigue
 - Sleep loss previous night
 - Tiredness after a day of work (e.g., demanding day)
 - Can be compensated for and quickly overcome!
- Cumulative fatigue
 - Longer term sleep loss
 - Inadequate quality and quantity of sleep
 - Overcome by extended sleep
 - Two night recovery period

HERALD OF FREE ENTERPRISE

1987

Ferry capsized on the night of
6th March 1987 killing 193
passengers and crew

The captain was on a break
and thought to be asleep in his
cabin



CLAPHAM JUNCTION

1988

12th December 1988 - 35
people died (484 were left with
injuries)

Collision the result of signalling
failure – technician had not
been told his working practices
were wrong AND his work had
not been inspected

In addition to this, he had also
performed the work during his
13th consecutive week of 7-day
work weeks



This led to fatigue
prevention policies
and
recommendations for
industry guidance

TEXAS CITY

2005

23rd March 2005 – explosion
killing 15 workers and injuring
more than 180 others

Implication = result of extensive
periods of 12 hour shifts



MELTON MOWBRAY

2006

Derailment of a freight train near Melton Mowbray on 9th February 2006



Immediate cause = driver had a microsleep approaching the danger signal, and was only woken after the train had derailed

Driver was suffering from fatigue and had not slept for 22 hours

WARNING SIGNS OF FATIGUE!

Fatigue management guide 2005

- Desire to sleep
- Lack of concentration
- Impaired recollection of timing and events
- Irritability
- Poor judgement
- Reduced capacity for effective interpersonal communication
- Reduced hand-eye coordination
- Reduced visual perception
- Reduced vigilance
- Slower reaction times

HOW CAN ORGANISATIONS REDUCE FATIGUE?





REDUCING FATIGUE

- Fatigue management policies
- Sleep contracts

<http://www.hse.gov.uk/humanfactors/topics/fatigue.htm>



SLEEP CONTRACT

- "A sleep contract can be defined as: 'a negotiated and agreed framework for managing fatigue on a day-to-day basis that is integrated into an organisation's existing safety management system. The framework is formally documented and makes it clear that employees and management are jointly responsible for the management of fatigue risk and states the responsibilities/ accountabilities of each party.'"



GENERAL HSE VIEW

- As with any health and safety issue, the law requires duty holders to eliminate the risk if possible
 - E.g., to consider whether shift work is necessary in that business...
- Employers should:
 - Consider the risks of shift work and the benefit of effective management
 - Establish systems to manage the risks of shift work
 - Assess the risks associated with shift work in their workplace
 - Take action to reduce these risks
 - Check and review shift-work arrangements regularly

LEGAL DUTY

- General duties under the Health and Safety at Work Act
- Management of Health and Safety at Work regulations
- Specific duties under the Working Time Regulations (WTR)

REDUCING THE IMPACT OF FATIGUE

- Strategic napping
- Bright light exposure
- Pharmacological interventions
 - Psychostimulants
 - Caffeine
 - Hypnotics
 - Melatonin
- Exercise

*Boivin, Tremblay and James (2007)
Caldwell et al. (2009)*

1. STRATEGIC NAPPING

Guidelines for using Napping to Prevent Commercial Vehicle Driver Fatigue (2007)





1. STRATEGIC NAPPING

- **Timing of the nap is important**
 - Preventative napping is more effective than recuperative napping
 - i.e., taking a nap 3-4 hours before a night shift is more effective than taking a nap once the person is already feeling fatigued
 - Naps between 2pm and 4pm are most effective



1. STRATEGIC NAPPING

- **Timing of the nap is important**
 - Naps are easiest to take between 2pm and 4pm, and between midnight and 6am
 - Relates to our natural circadian rhythms and natural sleep patterns
 - Naps in the early hours of the morning are more likely to result in grogginess – sleep inertia (up to about 30 mins of waking)
 - More likely to go into a deep sleep



1. STRATEGIC NAPPING

- **Duration of the nap and napping environment is also important**
 - 15, 30, 60, 120 minutes??
 - Mixed views on the duration of a nap – seems to depend on timing, where the nap is taken or time available (at work or at home), and whether preventative or recuperative, etc

2. PHARMACOLOGICAL INTERVENTIONS

- Modafinil for shift work sleep disturbance
 - Non-amphetamine psychostimulant used to increase certain aspects of cog. Functioning
 - But, findings show increased difficulty to fall asleep when the opportunity for sleep came
- Caffeine
 - Effective dosages vary (50-300mg)
 - Timing is important
 - Best used in tandem with napping – e.g., 300mg of caffeine plus 1-2hr nap, taken 3-4 hours before a night shift

2. PHARMACOLOGICAL INTERVENTIONS

- Hypnotics for insomnia
 - 19% of Air New Zealand pilots reported having used prescribed hypnotics for the treatment of insomnia
- Melatonin
 - Unpredictability in effective dosage and formulation
 - Can directly promote daytime sleep
 - Natural melatonin peaks at night during the middle of a sleep episode – so melatonin is best taken at approx. the desired sleep time.

FOLKARD AND LOMBARDI (2006)

The estimated risk of an injury or accident associated with any given number of weekly work hours varies substantially depending on how work hours are comprised. The risk depends on the length and type of shift, as well as the frequency of rest breaks.

We conclude that placing a limit on the risk associated with a particular work schedule is likely more effective than setting daily, weekly or monthly work hour regulations in keeping workplace safety within acceptable limits



HSE FATIGUE INDEX

- Development of the HSE Fatigue Index based upon analysis of accidents and shift work patterns
- Higher score = higher probability of a person feeling extremely fatigued
- Validated with Karolinska Sleepiness Scale

<http://www.hse.gov.uk/humanfactors/topics/fatigue.htm>
<http://www.hse.gov.uk/research/rhhtm/r446.htm>



HSE FATIGUE INDEX

- Fatigue Index Calculations based upon:
 - Cumulative fatigue
 - Time of day shift length
 - The effect of breaks
 - Recovery from a sequence of shifts
- BUT! No thresholds/cut-offs for 'unsafe' levels of fatigue



SHIFT WORK AND HEALTH

- HSE regards fatigue as a key established health effect
- Fatigue can itself create other adverse consequences such as accidents, injuries and other H&S failures
- Also suggestion that fatigue leads to detrimental health effects and social effects



ANY QUESTIONS?