Health, impairment and risk in transport

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Safety critical tasks – characteristic of transport sector

- Tasks where impairment of one person – usually a worker - can put others at risk.
- Accident risks predominate
- Often multiple contributory factors and shortcomings.
- Probability and severity of risk from impairment may be mitigated by management and engineering systems.

What is contribution of 'medical' factors to human performance envelope and limits?

- Visual –acuity, colour, visual fields/ spatial awareness, visual recognition, eye disease
- Physical – musculo-skeletal, cardio respiratory/ size, fitness, ageing
- Incapacitation – seizure, arrhythmia, insulin/ fatigue, vigilance, attention.

Evidence of contribution limited - problems of incident investigation.

Road crashes

- Road user factors dominant cause >65%
- Medical causes narrowly defined <1%
- More important:
  - driver behaviour
  - cognitive impairment
  - fatigue
  - alcohol/drugs/medications

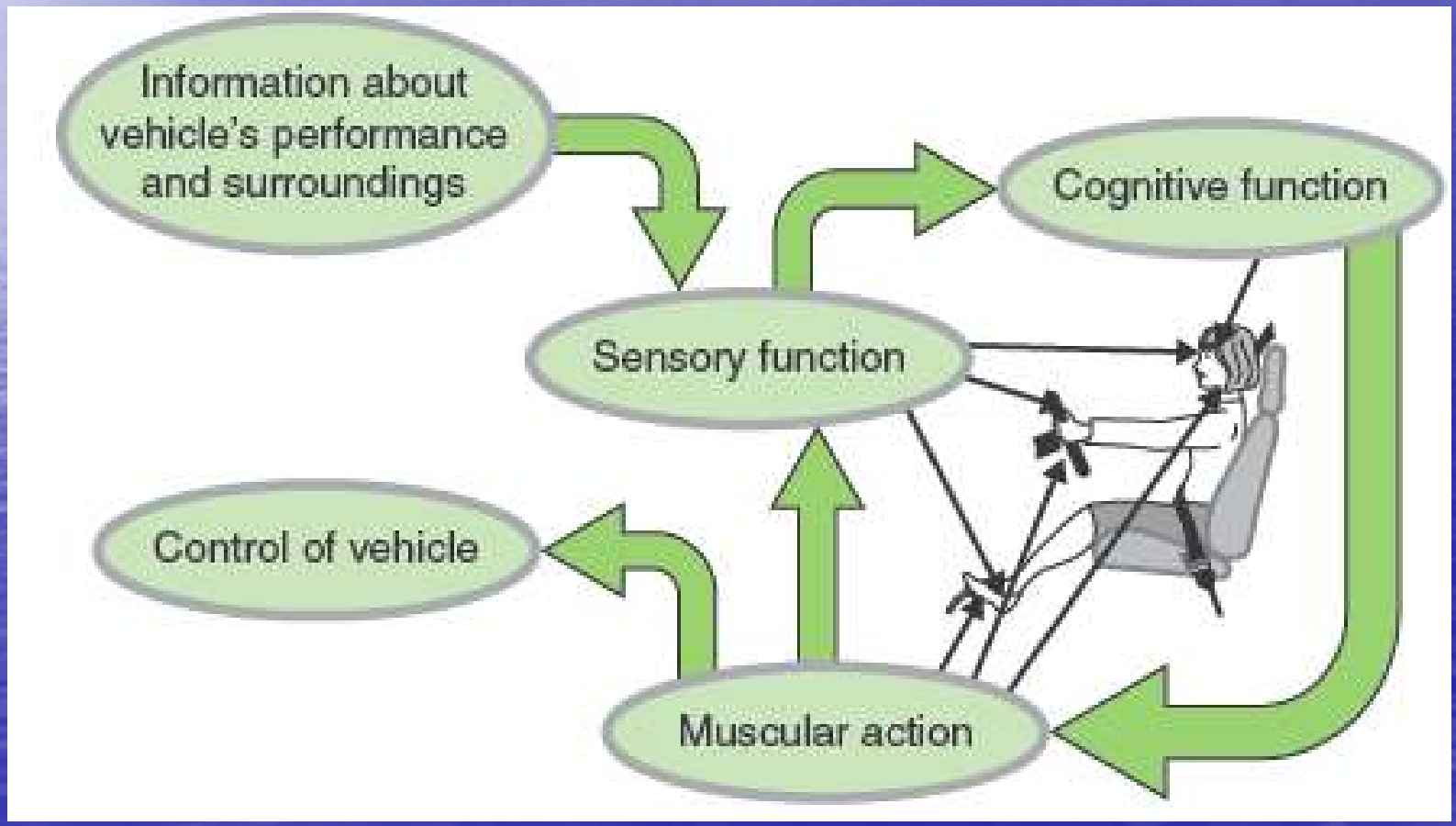
All have health related components – multi-causal human factors model needed.

Time course of health related impairment

- Static – colour vision, amputation
- Slowly progressive – osteoarthritis
- Fluctuating – multiple sclerosis
- Recurring – asthma
- Rapidly incapacitating – cardiac arrhythmia, seizure. How rapid? Seconds, minutes, hours.

Assessment – individual performance , prediction from population risk estimates.

Impairment usually leads to ineffective perception>cognition>action loop

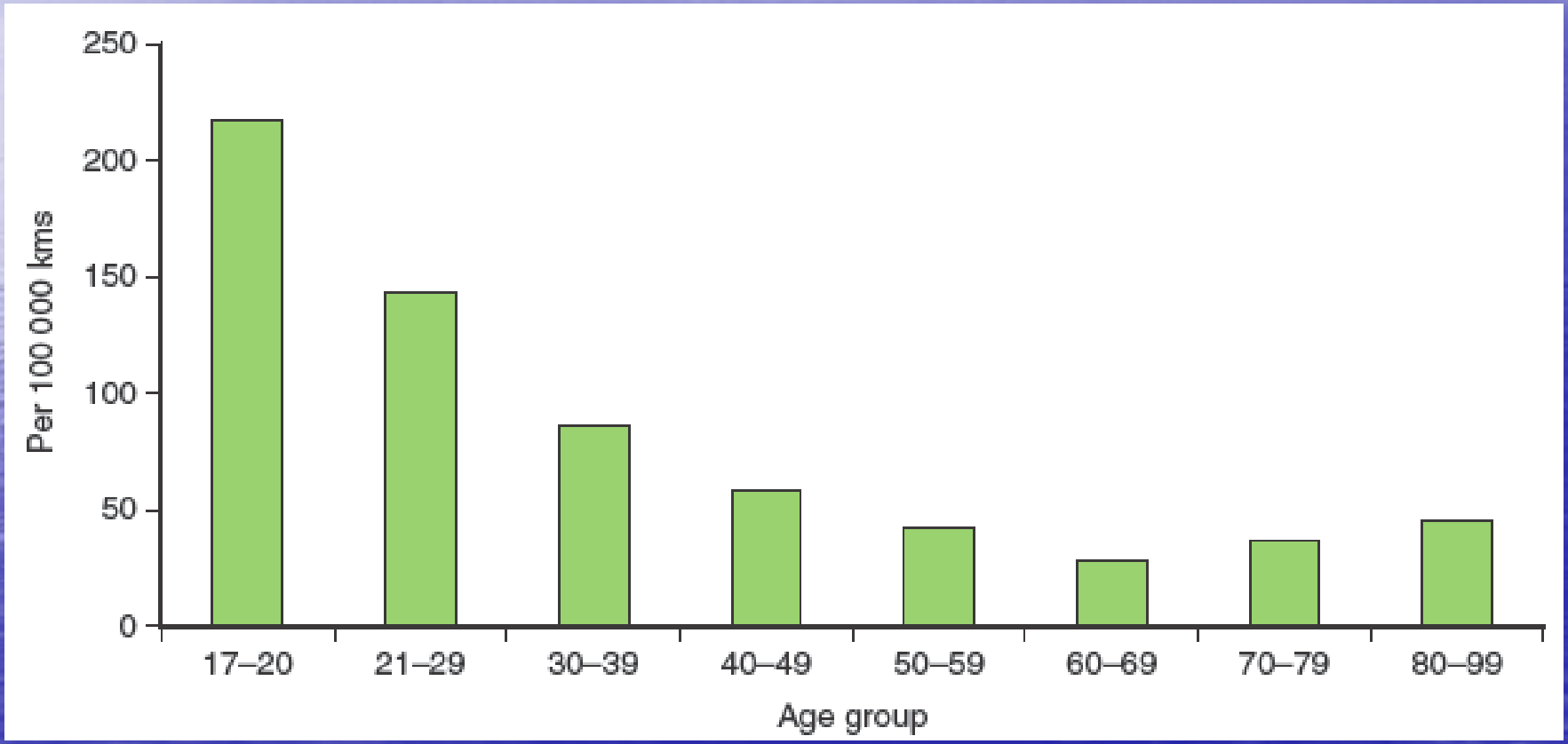


Example: cognitive impairment

- Fatigue: many factors: work overload, loss of rest, sleep disorders
- Chemical: alcohol, medication, drug misuse
- Developmental: brain damage, dyslexia, ADHD, ageing, dementia
- Functional: behaviour and personality, prioritising of attention, memory and experience.

What is medical fitness?

What matters? – Road crashes
How much does health matter?



Drivers and riders killed or seriously injured by age group

Physical capability – job specific

- Strength, flexibility, stamina, reserves
- Practical testing: on job, training courses, everyday tasks
- Pattern of exercise
- Clinical assessment – physique, weight
- Formal tests: cardiorespiratory reserve, gym based.

Maritime and rail emergencies

Sudden incapacitation

- e.g. seizure, cardiac arrhythmia, insulin, sleep disorder.
- How likely? – probability. Baseline level for first event. Excess risk – previous incident or risk factor.
- How rapid? Seconds, minutes.
- Is there prior warning without cognitive impairment?

Studies of events and risks – aviation, rail, road.

Seizures

- Post head injury/neurosurgery
- Idiopathic epilepsy
- Provoking factors
- Cerebral metastatic risk in carcinomas
  Quantification from general population epidemiology- frequency, consequences
  <2% p.a. - sea, rail, commercial vehicle
  <20% p.a. - car driving

Cardiac events

(Infarcts, arrhythmias, angina, surgery etc.)

Risk - severity of damage, time since event, therapy, risk factor modification

Assessment - history, exercise testing, vessel patency.

- Aviation - 1% p.a. risk of fatality
- Rail, vocational road - exercise testing
- Sea- task related

Sleepiness and driving – a medical issue?

- Majority of sleep related crashes are in young drivers who have not slept enough
- Those with obstructive sleep apnoea have an excess crash risk and this is prevented by CPAP.
- What are the messages to give to drivers as a whole?
- What approach is needed for sleep disorders?

Evaluation of risk - elements

- Job and task demands
- Personal capabilities and any impairment from health
- Present state assessment – practical, predictive testing
- Determination of prognosis – actuarial, stratification of future risk

One ship many tasks

4 pictures
Ship
Master
Engineer
Stewardess

Secondary effects of illness at sea

- Risk to individual from limitations on treatment
- Risk to others – infection, behavioural
- Risk to vessel – loss of crewing level from illness and from care needs.
- Risk from evacuation – helicopter, unplanned diversion.

Consequences of failure to comprehend risky situation

- Road – rapid development of accident situation. Most incidents not major.
- Rail – mechanical safety back up. Major incident risk.
- Air – back up systems most of time. Major incident risk in commercial flying.
- Sea – usually thinking and scanning time if visibility good, some back up systems. Risk of vessel loss but often crew can escape.

Modes of transport and vision

- Road – complex rapid changing scene, speedy vehicle responses, multi directional search.
- Rail – colour signals, mainly repetitive vigilance tasks, slow response of train.
- Air – short periods of high visual demand, complex cabin display.
- Sea – poor visibility, colour signals, slow response, tedium.

Eye and brain

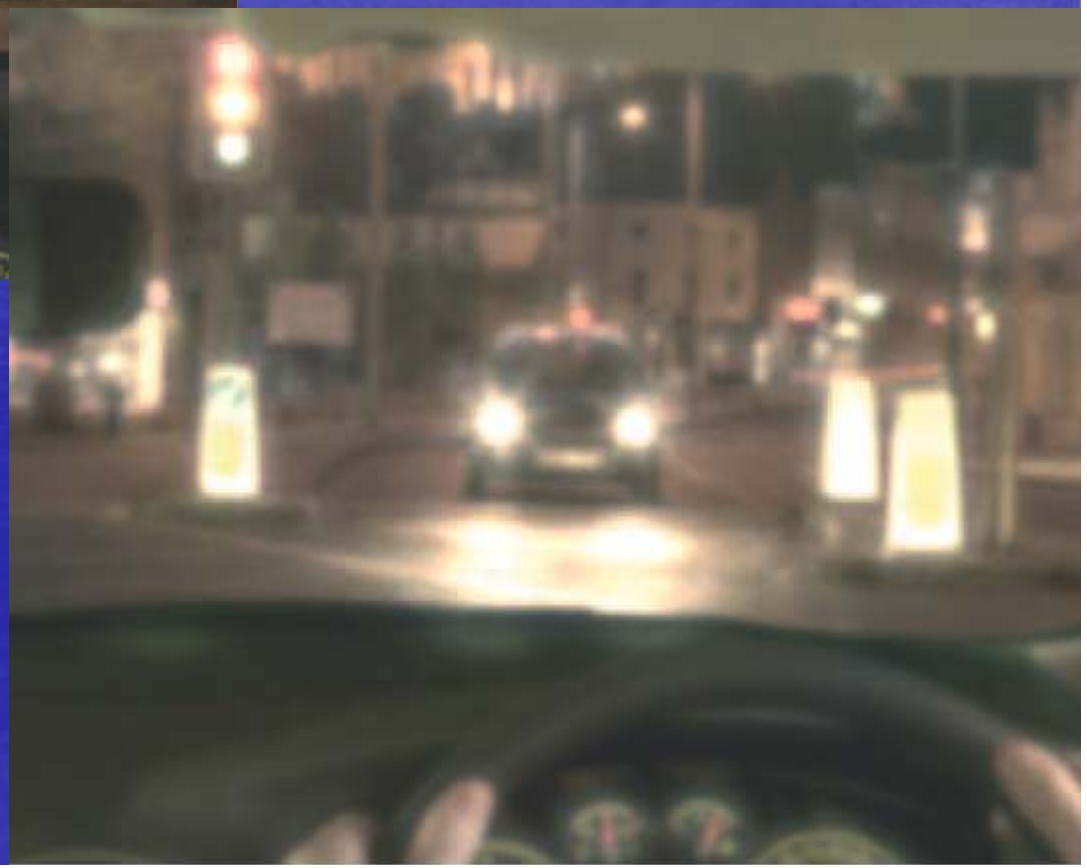
- The processing of visual information,
  - its use to determine search strategies,
  - it's interpretation in the light of training, experience and cognitive ability.

All have been shown to be correlated with accident risk.

- The correlation of specific levels of visual (camera function) capability with accident risk is much weaker.

The ageing eye

Night driving, glare and loss of visual acuity



Even worse than this on a wet night!

Eye disease: present state and prognosis

Simulated visual Loss in glaucoma

Vision and risk management

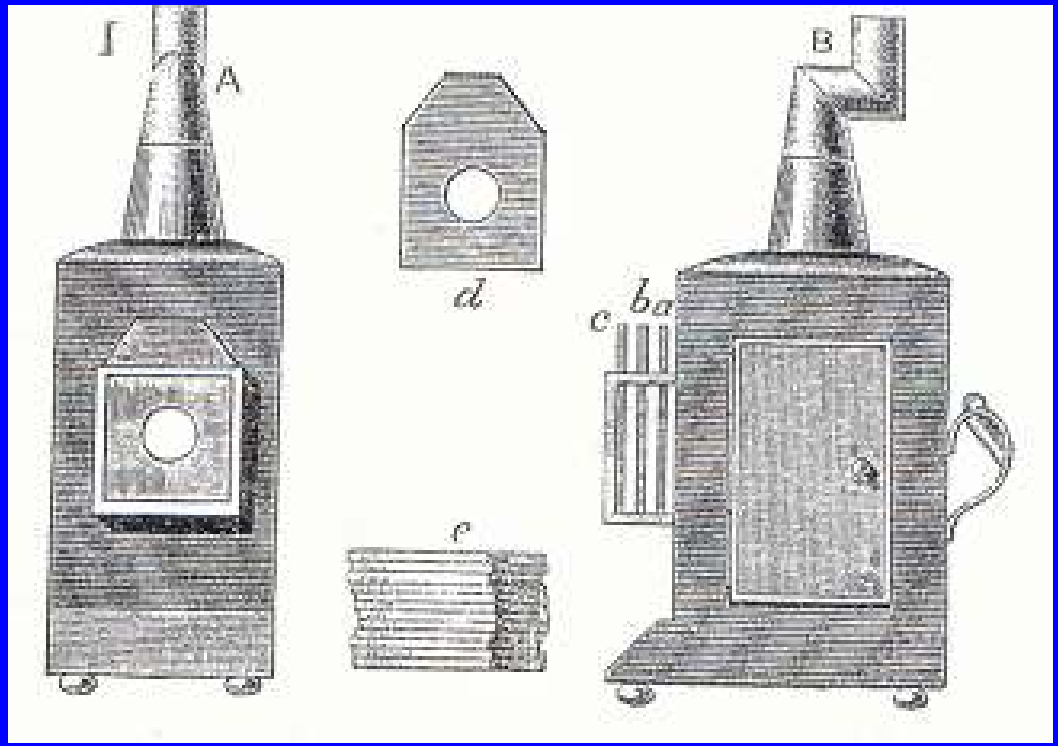
- How should we balance public safety and loss of opportunity?
- Should standards be set in the absence of clear evidence of risk?
- Why do we use static tests when most of the risks are dynamic ones?
- Why do we just look at camera functions and not at whole of visual perception?

Colour vision in seafarers – a cautionary tale

- 1850's red and green navigation lights
- By 1880 many accidents recorded from inability to discriminate
- Invalid testing procedures introduced
- In UK 1910 major parliamentary enquiry of Mr Trattles case led to more valid lantern test
- We still exclude 5% of male population from deck officer posts at sea! Why keep these colours?

Lantern and Lecture

15 July 1911



THE DISCRIMINATION OF COLOUR.*

BY

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‘Rational’ Standards

- Risk assessment - scientific based on review or research, to include uncertainties
- Risk tolerability - political, benchmarking, trade-offs, accident experience
- Standard based on assessment and tolerability, with allowance for uncertainties
- Evaluation of standards in use

Take away thoughts

- Health related impairment cannot be isolated as a distinct cause of transport accidents
- Integrated human performance approach needed
- There is reluctance (aviation excepted) to accept integration
- Does the reluctance to integrate come from managers in transport of from medics?

THANK YOU FOR LISTENING