



ECA
Piloting Safety



Aging re-imagined?

The aging pilot panel

COGNITIVE AND
PSYCHOMOTOR FACTORS
in AGING PILOTS

K. Mesarosova, EAAP

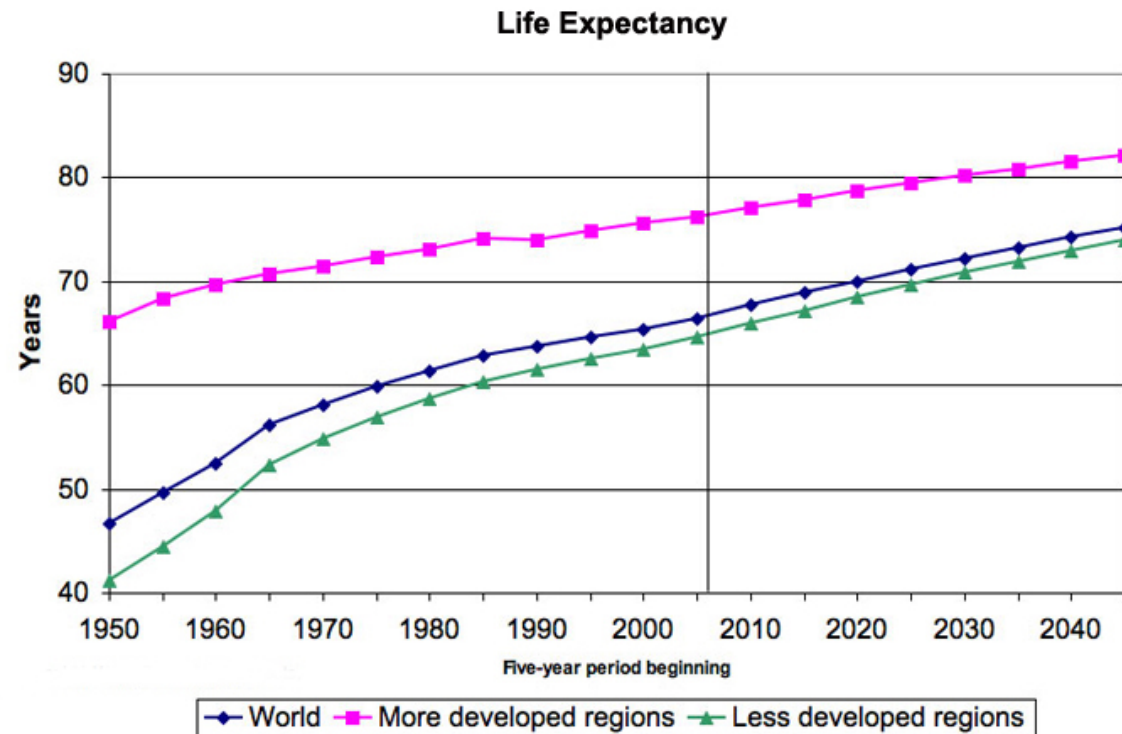
International Congress of Aviation and Space Medicine

When are you
planning to
stop driving?

When you are
60 or 65?

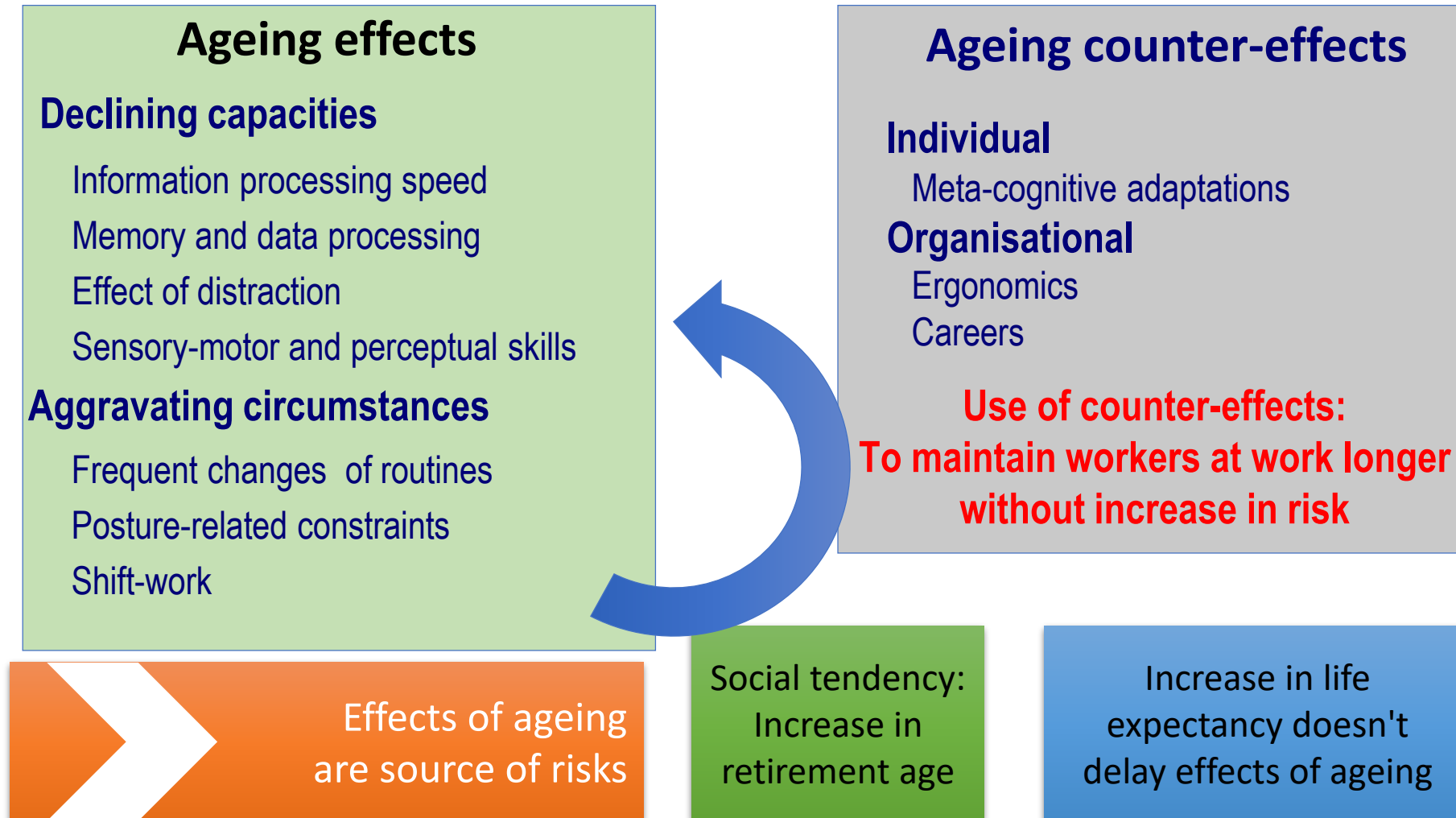


What is the point of no return?



United Nations (2004) World Population Prospects.

Ageing of workers is a concern in the industry.



Ageing of workers is a concern.

- Age and ageing are not explicitly managed (no policy about ageing).
- Only **three** age milestones are defined:
 - Minimum age to begin
 - Medical checks frequency changes at 40
 - Maximum age to end: **an economic adaptation variable**
- Flight crews:
 - Demography is what the economic needs make it
 - Filtered through medical and performance checks
- Most pilots manage to remain in the pipeline:
 - Well-paid jobs, social status, seniority list (older pilots fly in better conditions).

Age 60 Rule: FAA – 1959 wording

- The explanation of implementing **the Age 60 Rule (1959)**:
 1. aging leads to **progressive and unpredictable** deterioration of certain physiological and psychological functions;
 2. no method can be used to detect the deterioration of aging;
 3. sudden incapacity might be induced by the increasing risk of cardiovascular disease among older people;
 4. the ability to learn is known to decline with age.

Previous Studies -The Origins of the Age 60 Rule

- **1959:** Context of the arrival of the Boeing 707 and Douglas DC8
- **1960:** The FAA establishes the age of 60 as the upper age limit for commercial transport pilots, irrespective of their health, experience and level of performance (age 60 rule).
Fear of Disabilities in Flight & Fear of less ease of learning
- **1972:** ICAO introduces in Annex 1 (license) the concept of upper age limit of 60 years for commercial transport pilots
1992: "Age 60 study" by the FAA = What is the reality of the risks linked to aging?
- **1994:** The authors of the study (Kay, Harris et al) believe that the hypothesis that the crash rate of commercial aircraft pilots increases with age.
- **1995:** The rule of 60 years is generalized during the merger Air France / Air Inter
- **1999:** The JAA prescribe a transition to 65 years of the upper age limit of commercial transport
- **2003:** Out of 116 nations, 18 have retained the age limit at age 60 and 72 range from 62 years to no limit
- **2006:** In March, amendment 167 to Annex 1 brings the upper age limit to 65 subject to the following conditions:
 - The CdB functions of international commercial air transport may be exercised by a pilot over 60 years of age (up to age 65) if the other pilot is under 60 years of age.
 - It is recommended that a copilot can perform this function until age 65 (with the previous condition)
 - International single-pilot commercial air transport pilots may not be over 60 years of age
 - A State may authorize COs over 65 years of age to operate on international routes provided that the countries overflowed authorize it

Previous Studies

- Wilkening (2002):
 - a critical review about the FAA's Age 60 Rule suggests that these decisions have been only **partially linked to the strengthening of security**.
 - short-term economic considerations formed the basis of the airlines' argumentation with the FAA .
 - no behavioral criteria could be accepted as reliable and relevant by the FAA. Therefore **only medical criteria would justify the choice of 60 years** for fear of flight disability and mental deterioration.

Wilkening (2002).The age 60 rule: age discrimination in commercial aviation. Aviat Space Environ Med. 2002 Mar;73(3):194-202.

Previous Studies

- Synthesis on the effects of aging by Aerospace Medical Association (2004):
- The various forms of age-related decline are manifested in contrasting ways when the effects of age are studied with aeronautical tasks and contexts.
- In this case, there is **no clear relationship between age and cognitive functions, experience and steering performance.**
- It is not possible to have a precise predictive approach to the effects of age.
- In 2006, David Bryman (Civil Aviation Medical Association) stated that maintaining this rule is not based on any medical basis to consider age 60 as relevant to a higher age limit for pilot activities.



Does age affect safety?

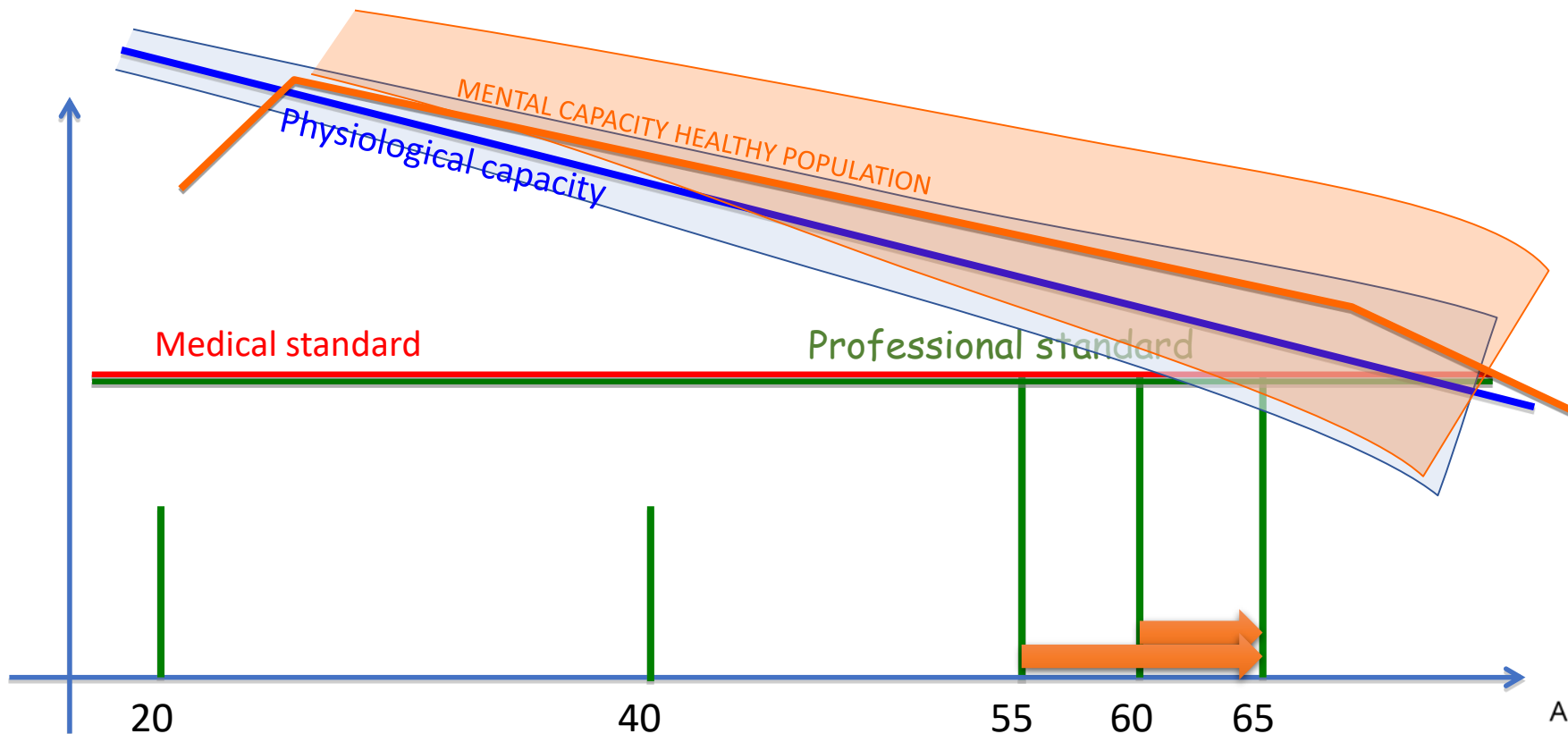
If so - how?

What is the cut off point?

The hypothesis of decline

- The decline in cognitive and physiological functions, health issues, suggests a lower performance with age (Hardy et al., 2007).
- Effects of cumulative selective conditions identified by ergonomics:

1. Frequent changes
2. Time constraints
3. Postural stress
4. The time difference



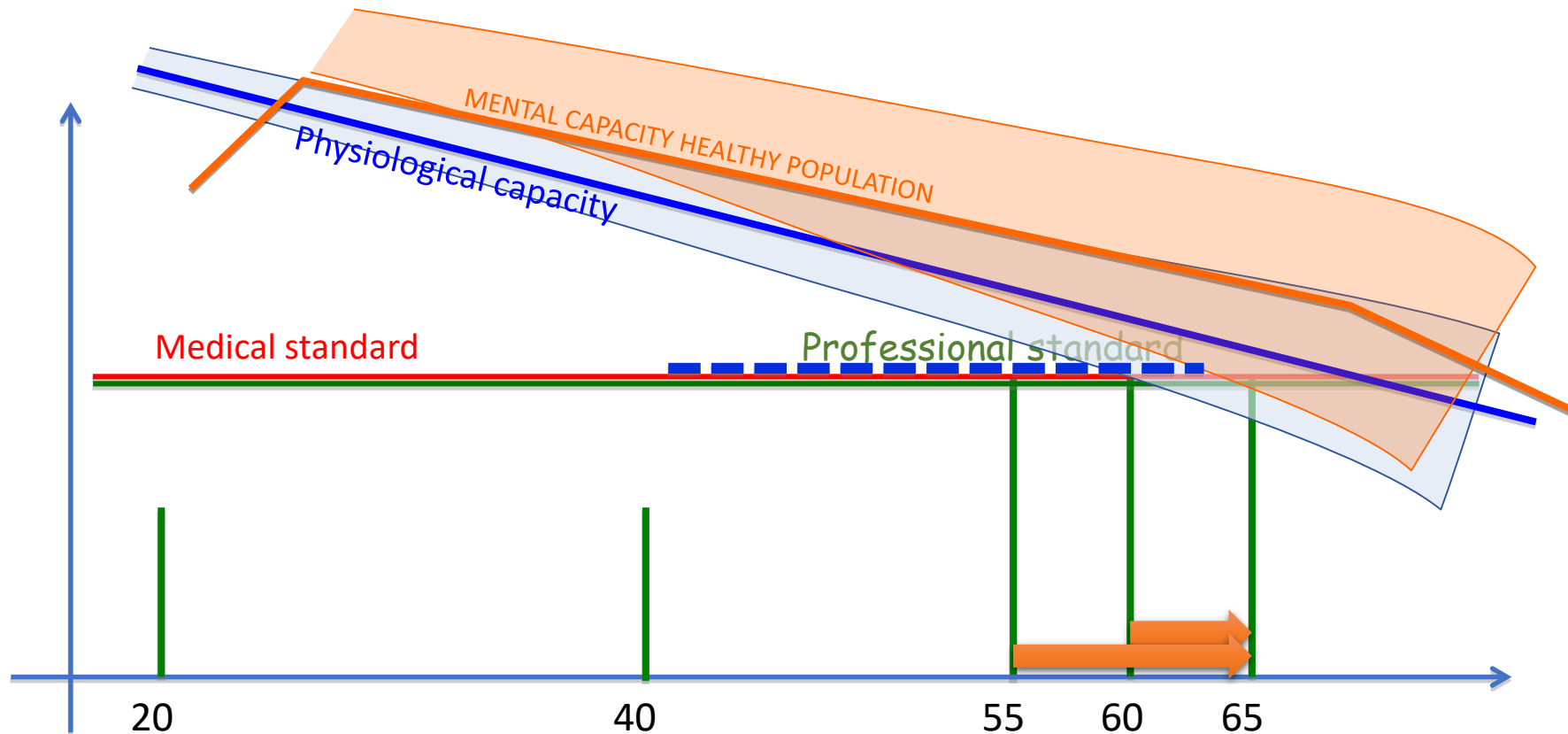
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Adapted from
Wilkinson, 2002

Literature - decline vs. compensation

- Numerous studies show that cognitive and physiological declines are compensated by compensatory strategies that allow them to remain above occupational requirements.



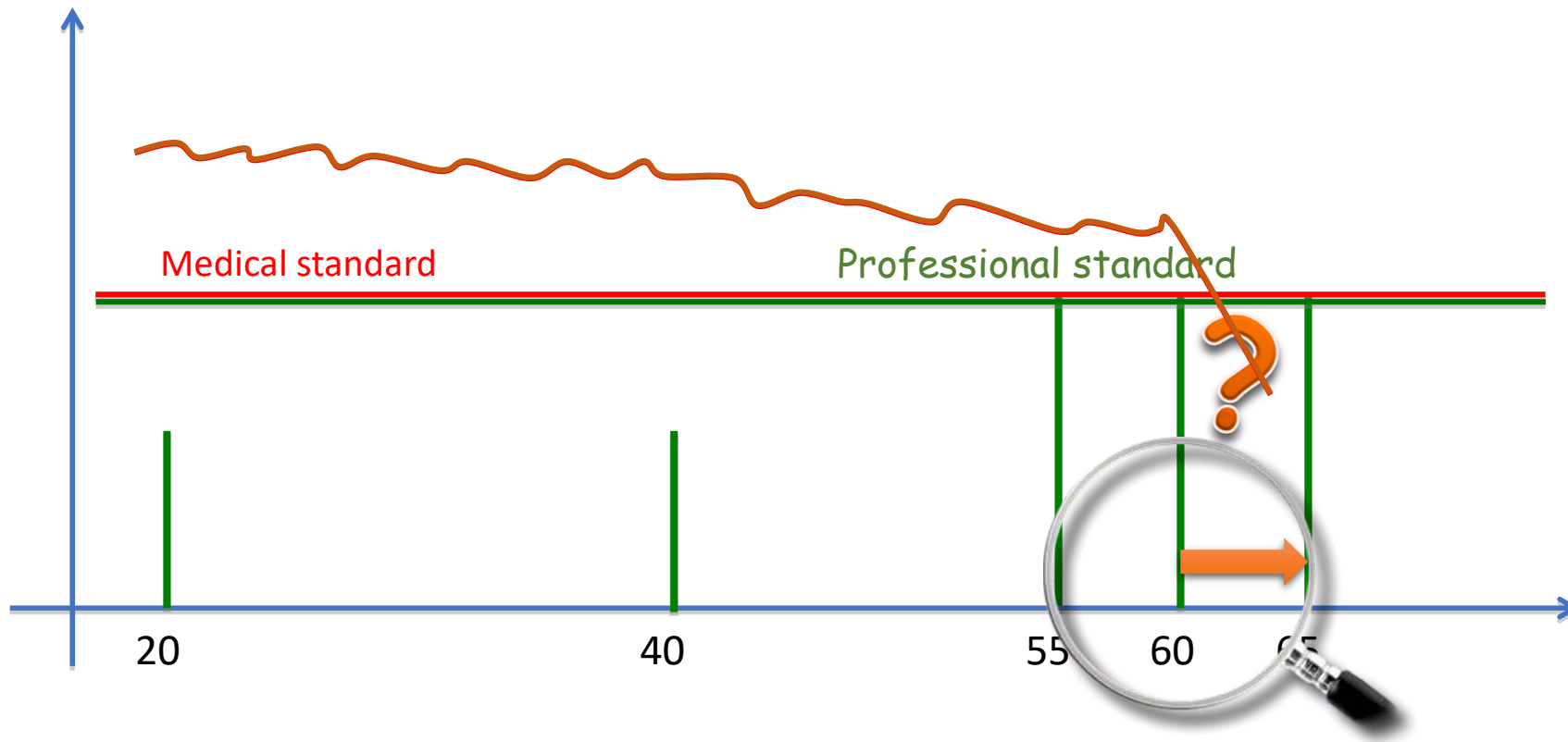
Strategies:

- Recurrent training
- Follow-up of periodic competence
- Unannounced checks by authority
- Peer observation in the community
- Interface Design

Compensatory strategies in aeronautical tasks = compensated decline?
Security retained?

Age & ability

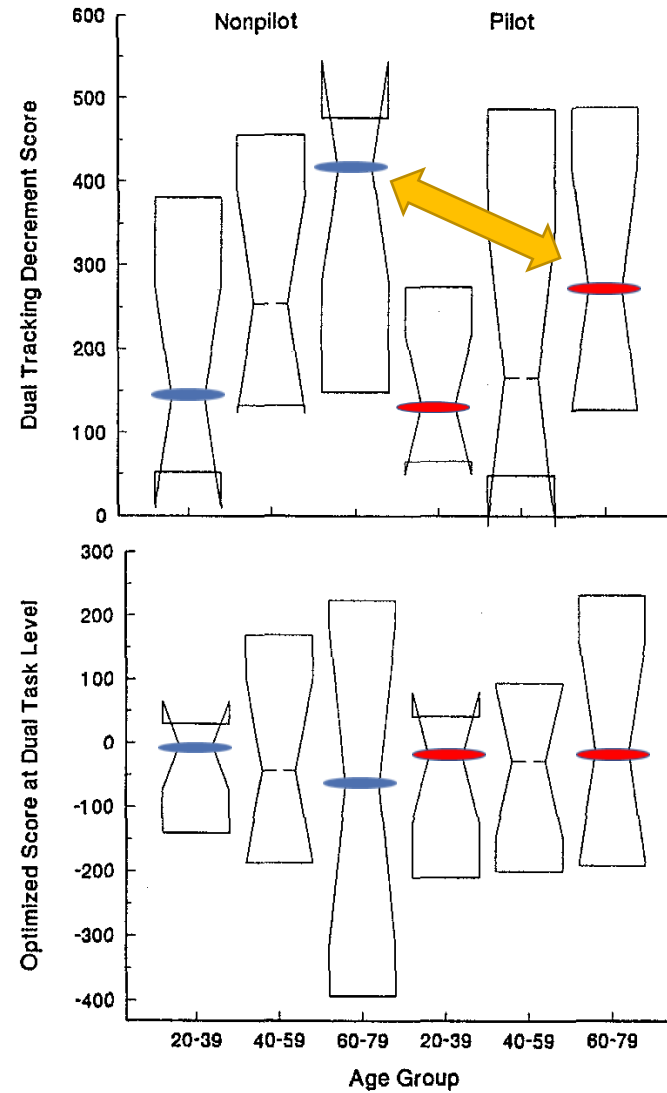
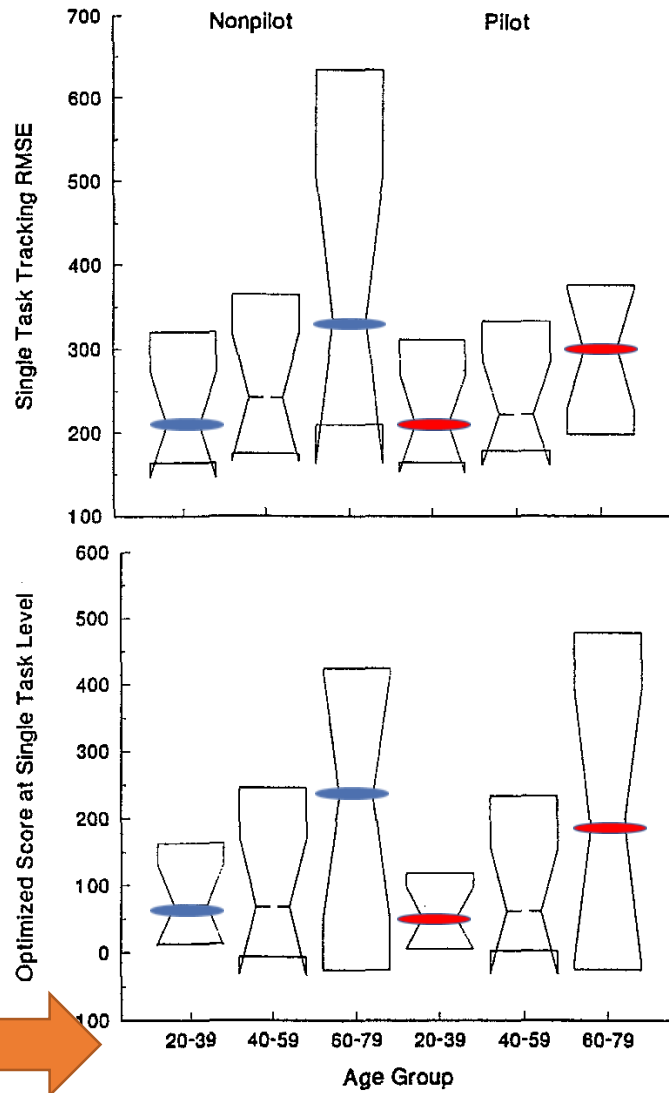
- Professional and Medical standards define the capacities to practice the profession:



Age - several factors to consider:

- domain-independent cognitive skills (basic abilities in memory, attention, etc.)
- domain-dependent knowledge (related to flying expertise)
- overall general intelligence

- pilot stressors: (e.g., fatigue, drugs, difficult weather conditions),
- pilot characteristics (personality factors, motivation, and **pilot age**).



- Divided into three age groups:
 - age 20 to 39,
 - age 40 to 59,
 - age 60 to 79.
- Comparing pilots and non-pilots
- Single task tracking
- Dual task tracking

Pamela S. Tsang & Daniel T. Voss (1996) Boundaries of Cognitive Performance As a Function of Age and Flight Experience, The International Journal of Aviation Psychology, 6:4, 359-377

Due to their superior education and health status on average compared to the rest of the population?

Perhaps due to extensive pilot experience and expertise as well as a possible protective factor or greater cognitive reserve they do they maintain themselves to some prescribed age and then abruptly fall?



Or does some combination of both patterns occur?

Age-related differences in pilot cognition do exist, it is apparent that experience does not completely protect fundamental cognitive skills.

Age-related differences in cognition are evident, the pattern of cognitive change in these abilities with pilot age are unknown

ACCIDENT INVOLVEMENT

- One GA-specific study based on National Transportation Safety Board (NTSB) accident data found that: among males age 55-63, 26% of crashes were without obvious pilot error compared with only 7% at age 40-49.

“Older pilots made fewer errors”

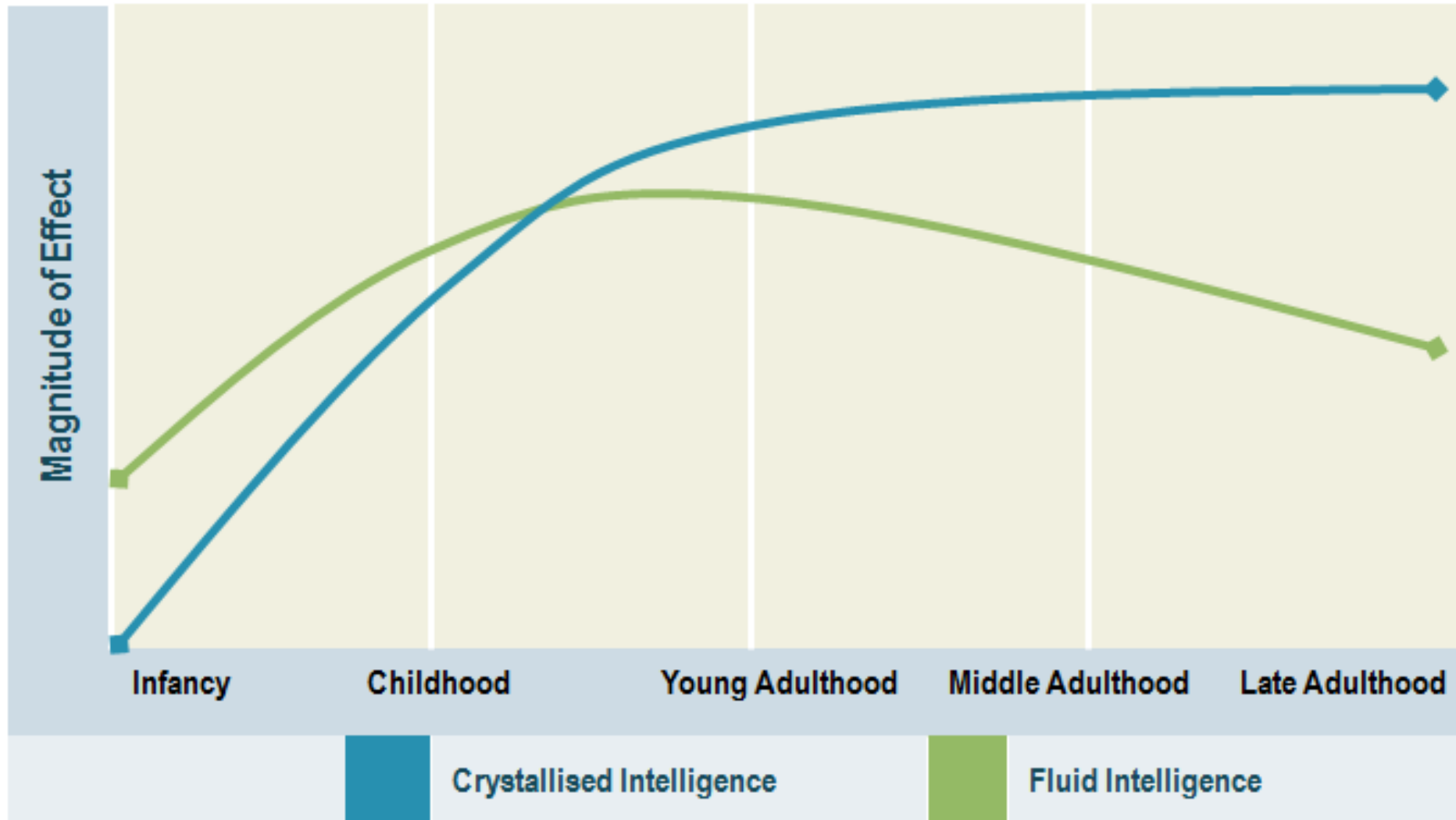
- Likewise, an 2006 Air Safety Institute study found that, starting at roughly age 55, pilots began to have more accidents than would be expected given their share of the pilot population.

SIMULATOR PERFORMANCE

- The “**Stanford Study**” addressed the aging among GA pilots.
- Over a 3-year period, the authors performed annual simulator testing on 118 GA pilots aged 40 to 69 years.

Performance was scored based on execution of ATC instructions, instrument scan, traffic avoidance, an approach to landing, and an overall score.

- More expert pilots had better:
 - flight summary scores at baseline
 - showed less decline over time.
- Secondary analyses revealed decline:
 - in the accuracy of executing aviation communications (STM).
- **Regarding age**, even though older pilots initially performed worse than younger pilots, over time older pilots showed less decline in flight summary scores than younger pilots. These longitudinal findings support previous cross-sectional studies in aviation as well as non-aviation domains, which demonstrated the advantageous effect of **prior experience** and **specialized expertise** on older adults’ skilled cognitive performances.”



Changes in crystallised and fluid Intelligence over the lifespan

The Annual Incapacitation Rate of Commercial Pilot

- A study by Evans and Ratcliff in 2012 (CAA) The Annual Incapacitation Rate of Commercial Pilots shows the following facts:
 16000 pilots in commercial flights
 39 disability on medical records
 7 concern over 60 years of age (cardio-cerebrovascular origin)
 The largest number of disabilities results aged 40 to 60 years.

Age Group	20-29	30-39	40-49	50-59	*60-69	
Male incapacitations (%)	2 5%	6 15%	11 28%	13 33%	7 18%	
Male pilots incapacitation (%)	11,5	33,2%	31,1%	20,1%	3,7%	
Rate per annum	0,11%	0,12%	0,23%	0,42%	1,2%	

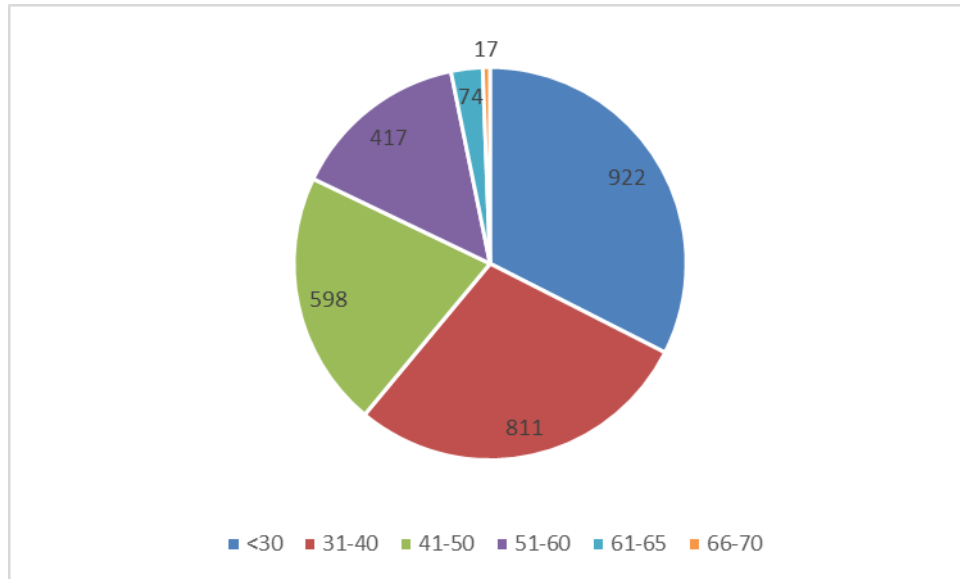
*Those over 60 are overrepresented because of their low numbers.

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Aeromedical studies suggested that advancing age did not necessarily correlate with an increased health risk for older pilots who were still **capable of passing the required** Federal Aviation Administration (FAA) medical exams.

Cognitive and psychomotor factors of licencing 60+ pilots for single-pilot aircrafts.

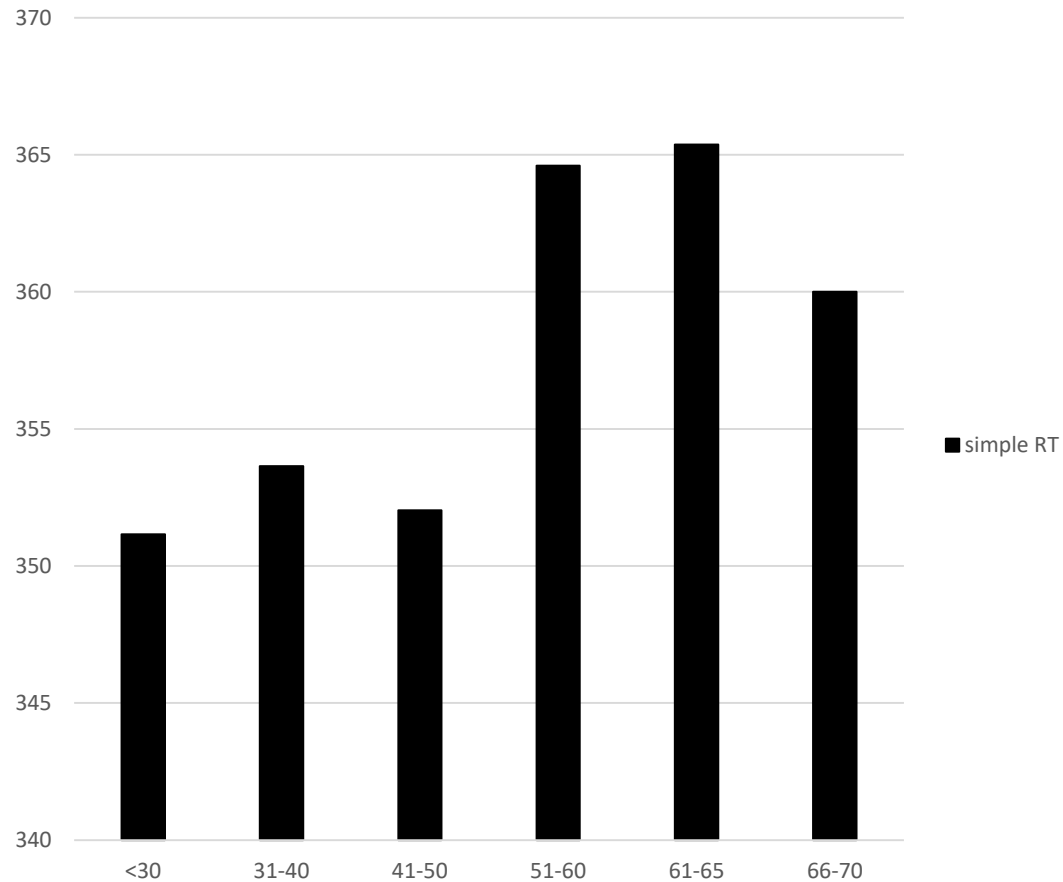
- Tarnowski (2015) Survey of 2712 active professional drivers



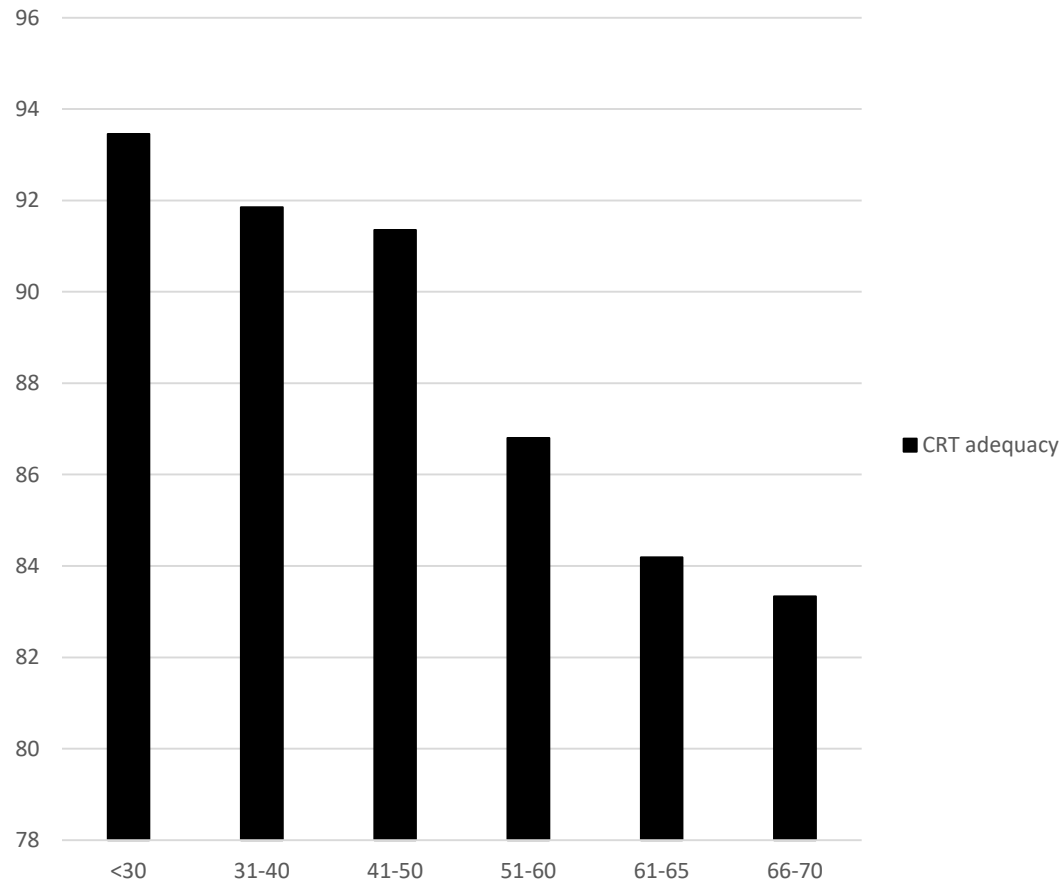
Aim:

- to estimate level of deterioration of crucial psychological functions after 60.
- Testing tool used: Speed and adequacy of reaction has been measured with
 - SIRT (Simple Reaction Test)
 - CHORT (Choice Reaction Test)
 - SPANT (Spatial Anticipation Test)
 - TRIT test, PAMT (Perception and Anticipation of Motion Test)

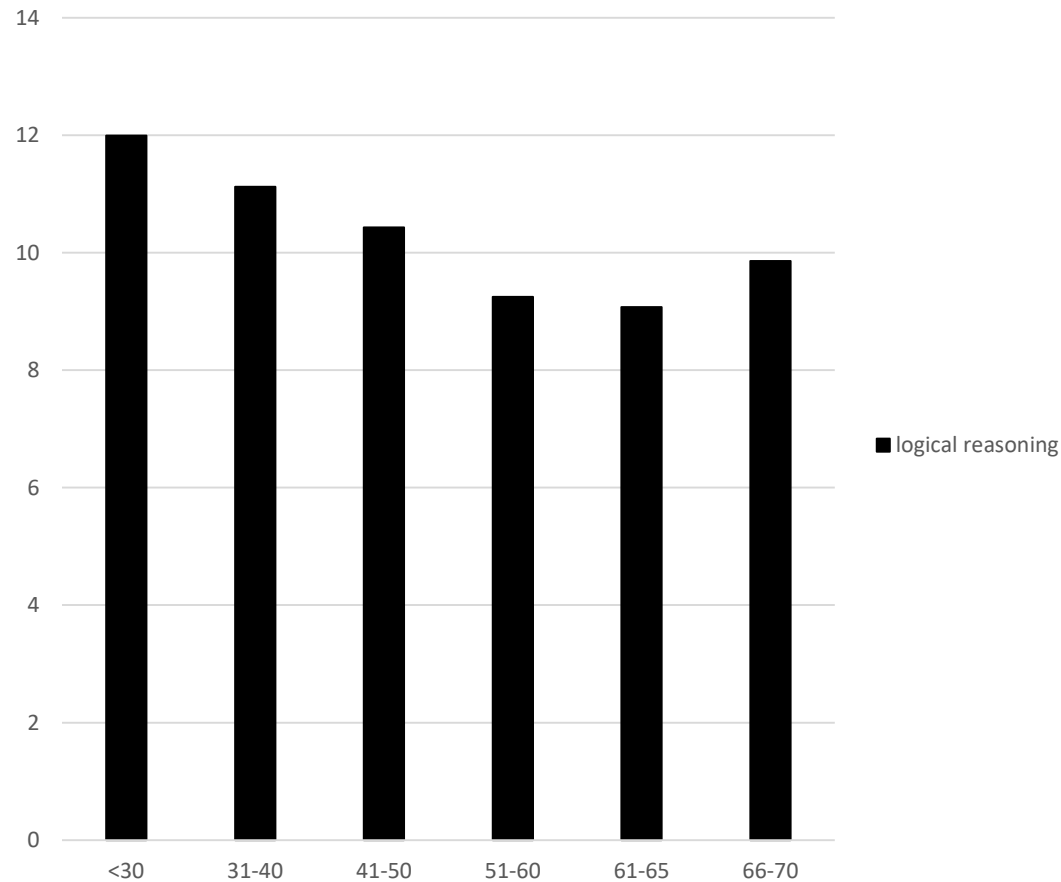
Mean simple reaction time



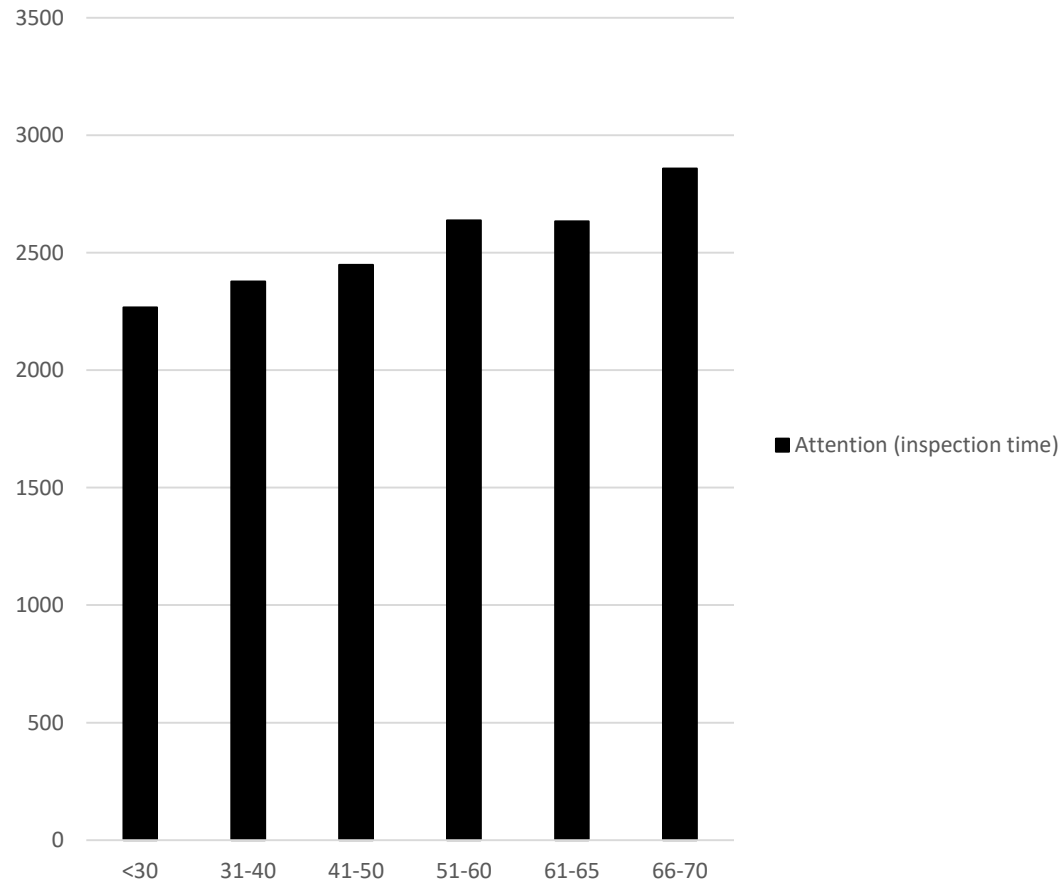
Mean score of correct answers in choice reaction time



Mean score in logical and spatial reasoning test



Mean inspection time.



Result

- The areas of “special care” were:
 - reactions in complex tasks,
 - speed estimation,
 - visual search.
- relatively stable
 - reaction speed,
 - logical reasoning,
 - coordination.
- The radical rule binding 60 year of life with absolute ban of single pilot aircraft licensing seems not to have empirical base.
- no substantial differences between psychological ability of active people aged 51-60 and 61-65.

Neutralization of ageing effects
in aviation

Trade-off and perspectives for the next decade

In brief

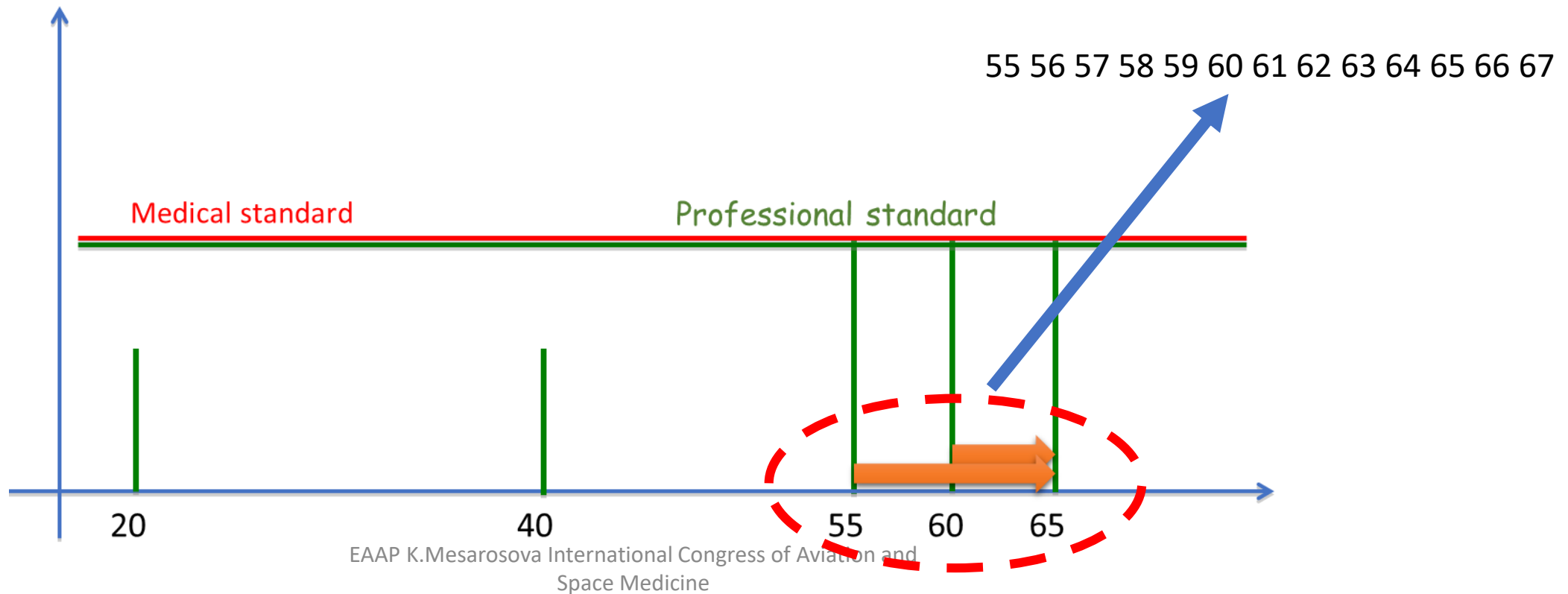
- Safety margins and coping strategies have been empirically developed over the 50 past years around the "age" parameter
- They seem to be efficient
 - No effects of crew ageing on safety evident by studies
 - Older pilots **seen** as better, safer (more experienced) ?
- Age seem to be neutralized, if u are able to pass the medical: no explicit adaptation to age with reference to context, technology, work duration, organisation, etc.

Is the age “under control” in the system?

- No evidence based knowledge about flight crew ageing effects on safety
 - Age data are collected only for accidents and critical incidents
 - Airlines don't monitor the effects of ageing
 - No studies on the mitigation strategies
- Major changes are coming
 - Decrease of incomes, decline of social status
 - Shift of age limit, overall ageing of western pilots
 - Growing productivity pressure
 - Low cost airlines
 - Extension of flight duration (18H) ; Longer time of duty
 - Reduced Training
 - Fast technological changes (automation)

Future research direction

- THERE IS A DECLINE..BUT WHERE exactly IS THE threat to safety?



Conclusion

- The absence of recognized age related problems does not mean safety.
- the current neutralization of age for pilots are quickly and deeply changing- it will not be possible without a proper understanding of “why it currently works”.
- These findings are encouraging to the extent that higher cognitive performance could translate to greater potential for an ability to acquire new skills and to benefit from training, thereby maintaining work performance at a high level.

Thank you.

