

# Ageing Aircrew & Accident Investigation

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# Ageing Pilots in the News



- May '05 Supreme Court refuses to hear appeal on challenge to Age 60 Rule
- Jan 2005 Bill to US Congress to end the Age 60 Rule for lack of evidence
- ZK DIS PA28 - Coroner calls for age limit for private pilots
- Geriatric astronauts Glenn & Melville
- Incidents UA 811 & 232
- ZK DLK - CFIT, ?age-related?



# Principal Concerns

- Pilot flying performance
- Perceptual deterioration
- Sudden deterioration
- Sleep and circadian rhythms
- Aircraft accident risk
- Pilot incapacitation risk



# Ageing & the Human Genome



- Life cycle theory: Birth-Development-Maturation-Reproduction-Ageing-Death
- “Random Damage Model” (Oxidative stress, free radicals, glycation)
- Programmed division limits
- Senescent gene experience theory (telomerase)
- Some combination of the above?

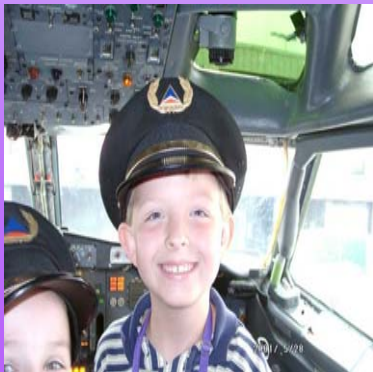
# 3 Ageing Processes



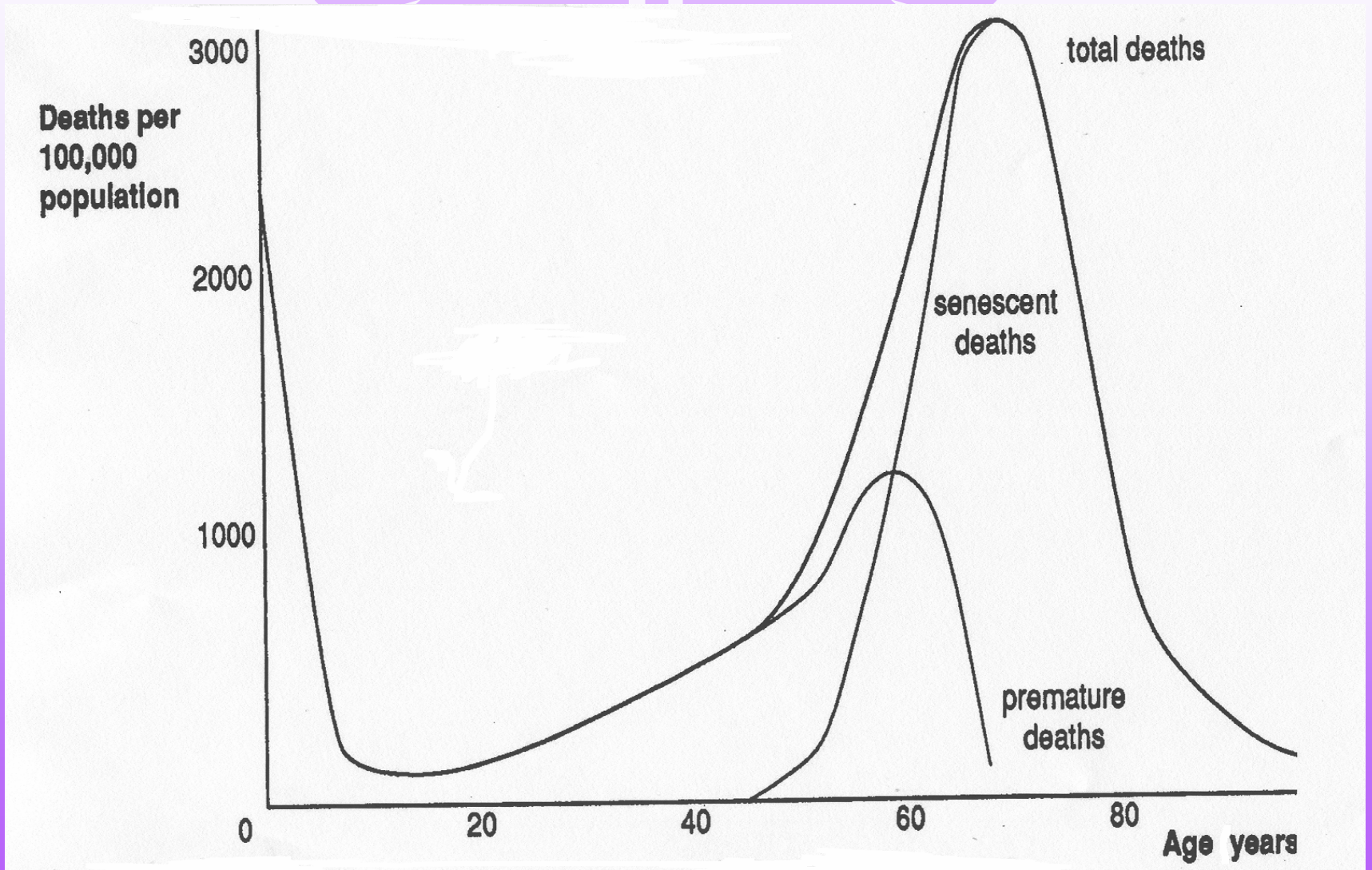
- Senescence ( $1^0$ )
- Life experiences
- Onset of diseases that increase with age ( $2^0$ )
  - ❖ All are non-linear
  - ❖ All occur at different rates
  - ❖ Occur at cellular, organ and organism level
    - ❖ Primary ageing - Irreversible
  - ❖ Secondary ageing - reverse the process, may reverse the ageing

# Can We Identify Ageing Patterns?

- Increment model
- Stability model
- Irreversible decrement model
- Decrement with compensation



# Mortality Patterns





# Changing Patterns



- Shift to right – longevity
- Similar patterns in morbidity onset
- Less Ischaemic Heart Disease, more cancer
- Activity & independence similar
- “Compression of Morbidity”
- Intergenerational factors
- Smoking

# Factors Affecting Ageing



- Genetic
- Dietary
  - Obesity
  - Anti-oxidants and disease factors
- Exercise
- Environmental
  - Cigarette smoking
- Psychosocial

# Genetic Factors

- **Family history of death & disease (Early dementias)**
- **Cultural differences**
- **Patterns of ageing consistent**
- **Possible Genetic Factors:**
  - Age of onset modifier genes
  - Pleiotropic genes
  - Reproductive energy
  - Genetic loading (unfavourable genes)
  - Gene/Chromosome repair

# Dietary Factors

- Starvation vs. Overweight
- Anti-oxidants
- Japanese and Mediterranean diets
- Unsaturated fats
- Salt
- Specific disease factors
- Alcohol



# Exercise



- Walking, gardening or vigorous exertion
- Several times a week
- Effects seen even with recent onset

# Environmental Factors



- Physical
  - high altitude?
  - ionising radiation only  $2^0$
  - atmospheric pollution
  - Ultra Violet Light - local skin &  $2^0$
- Chemical
  - Cigarette smoking
- Biological
  - Shift work/melatonin?

# Psychosocial Factors

- Cultural factors
- Access to health care
- Work – occupational or unpaid
- Attitudes to age
- Hygeine Factors
- Life events
- Stress??





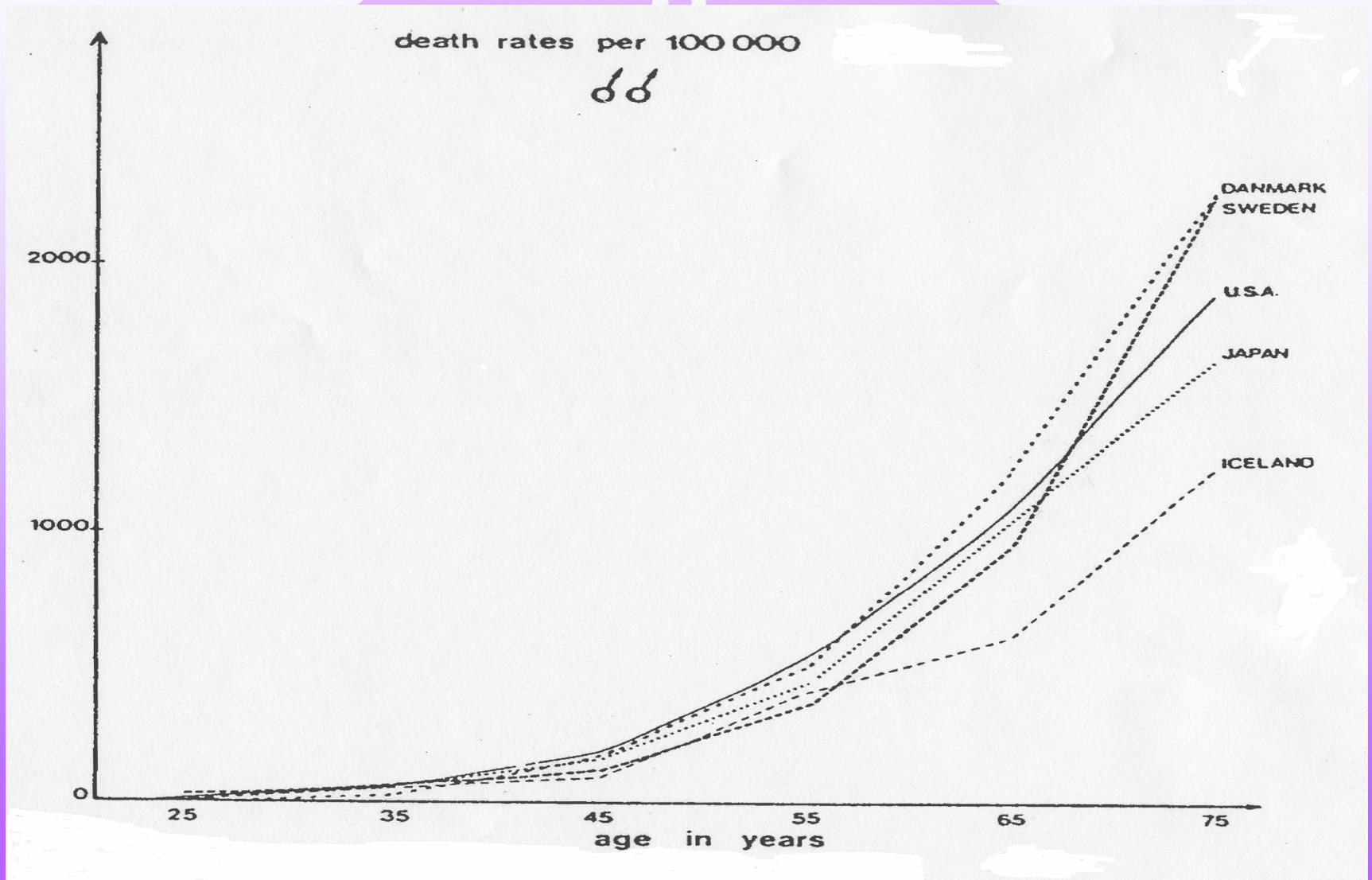


# Aging Physiology

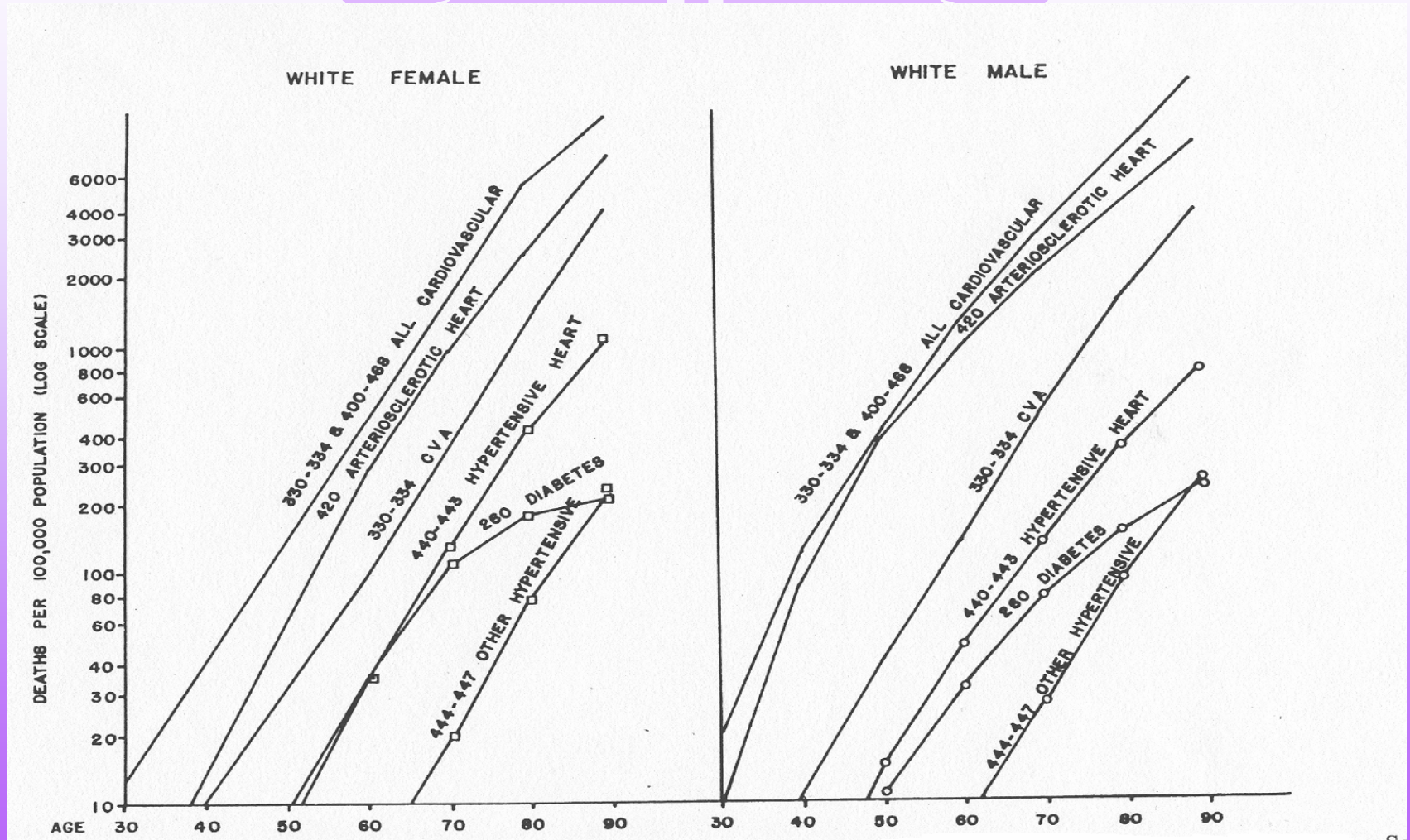


- Cellular
- Hormonal
- Immunological
- Perceptual
- Neurological
- Gastro-intestinal
- Genito-urinary
- Pulmonary
- Cardiovascular

# Age and Cancer



# Age & CardioVascular Risk



# Age & Physical Work



- Muscle bulk
- Power & strength
- Exercise capacity &  $\text{VO}_2$  max
- Endurance
- Joint mobility
- Ease & speed of movement

# Age & Vision



- Lens opacities & cataract
- Reduced lens flexibility
- Reduced & sluggish pupil size
- Colour perception
- Contrast sensitivity
- Depth perception
- Spectacles!

# Psychological Function & Age



- Cognitive performance
- Time perception & slowing
- Perception
- Learning
- Memory
- Psychomotor performance
- Decision making
- Attitudes, personality & behaviour
- Attention & time-sharing

# Age and Circadian Rhythms



- Shorter, lighter & more disturbed
- Earlier onset of REM sleep
- Increased “morningness”
- CR peaks and troughs earlier
- Impaired Time Zone adjustment
- 3.5x more sleep loss & daytime sleepiness
- Onset at age 40

1  
2  
N

...YOU WATCH A SWEET YOUNG  
THING-WHO THINKS THE  
ADCOCK RANGE INCLUDES THE  
MOUNTAINS WEST  
OF EL PASO-ACE  
YOU OUT IN A SPOT  
LANDING CONTEST!





# Age and Flying



- Gerathewohl 1978
- Golaszewski 1990
- Hyland & Kay, “Hilton” Study 1994
- Yesavage 1999
- Li accident study 2002
- Rebok 2002
- Morrow et al: Experience vz age 2003

# Golaszewski (1)

- Rates inversely proportional to recent flight time.
- Pilots with low amounts of recent flight time older pilots have more accidents than younger pilots but older pilots are less likely to have an accident than younger pilots if they have high amounts of recent flight time.
- When recent flight time is low professional pilots have more accidents than private pilots.
- Accident rates are inversely proportional to total flight time. Independent of total flight time private pilots have more accidents.
- Professional pilots up to 5,000 hours experience the older pilots have more accidents than young ones.

# Golaszewski (2)



- In private pilots the risk of accidents declines until age 60 when accidents become more likely.
- Pilots with more than a 1,000 hours total and less than 50 hours recent have most accidents, whereas pilots with over 1,000 total and more than 50 hours recent have the fewest accidents.
- For private pilots with low total flight time if they have more than one standard aviation less than the normal flight hours then their accident rates increase with age.
- Private pilots who have more than normal flight hours show no or reduce risk of accidents with age.

# Hilton Study (Hyland)

- Flying accuracy not proportional to total flying experience
- Recent flight time best related to performance
- Relationships unaffected by age up to 70 years
- Study limitations



# Yesavage 1999



- Simulator performance and age, Class I to III, ages 50 – 69
- Decline in performance with age
- Decline occurred at or before age 60
- Age contributed less than 22%
- May have been confounded

# Li & Baker 2002



- Studied commuter/air taxi pilots (Rule 131) involved in gen. aviation accidents
- Ages 40-49 and 50-63 years
- “Pilot error”: 73% young, 69% old (NS)
- No difference in type of error accident – attention, decision-making, manoeuvring or ground handling

# Rebok & Li 2002



- Aviation Experience Survey
- Younger & older airline pilots self-ratings of past 10 year trend
- Younger pilots rated themselves “better” to age 50
- Older pilots unlikely to self-rate themselves “worse”

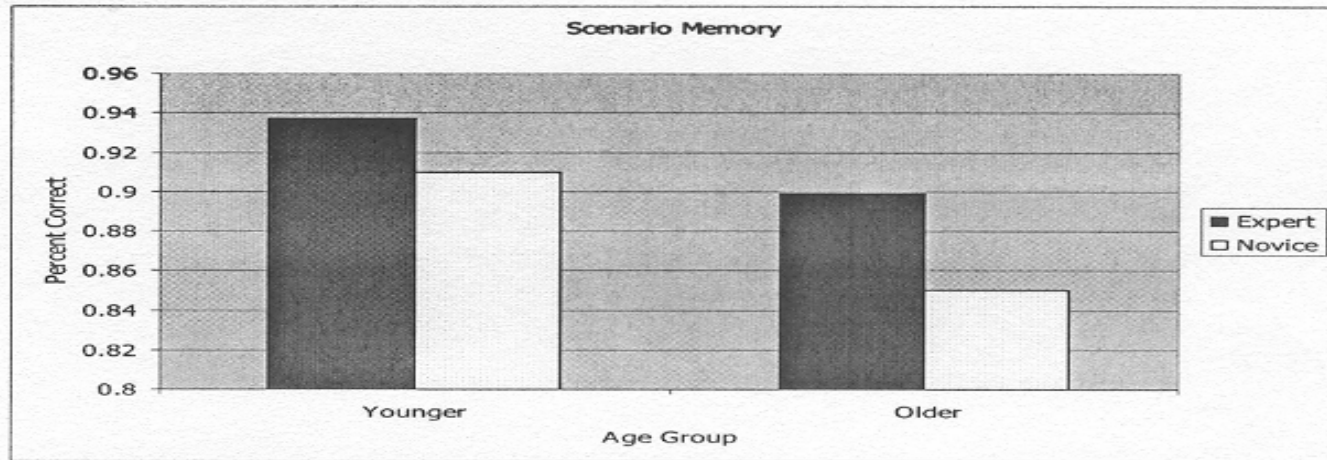
# Age & practice, flying experience/recency

- Morrow
  - 1994 – Expertise reduces some age decline
  - 2003 – Understanding correlates experience
    - Experts made better decisions
- Hardy – Metacognitive functions
- Tsang – Attention sharing
- Milke – Divided attention

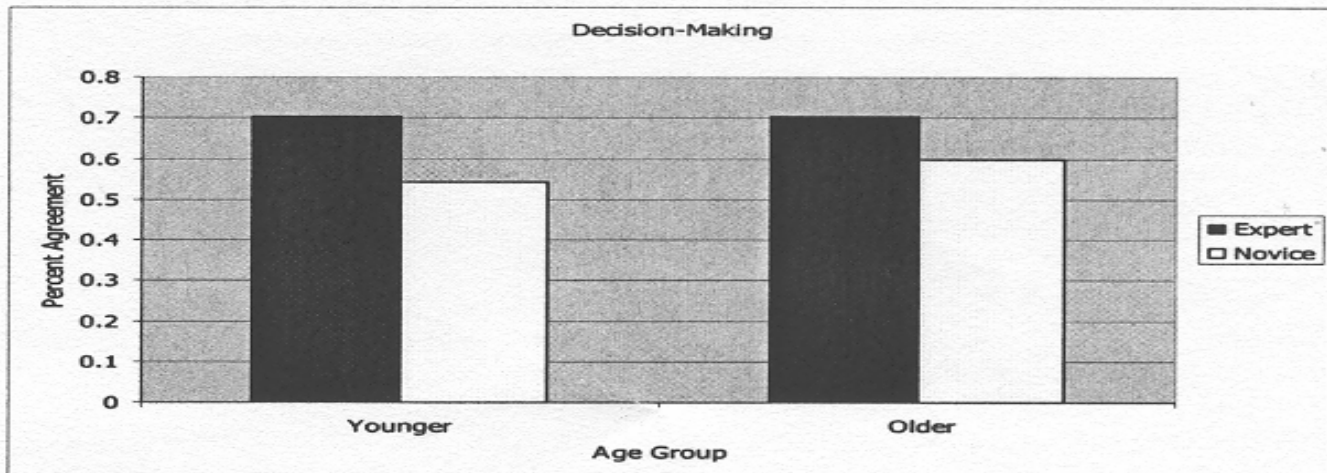


# Morrow

**Figure 2: Scenario Comprehension**



**Figure 3: Decision-Making**



# Age 60 Rule



- ICAO - PIC < 60, <65 Co
- JAA - <PIC only if OML, and no other OML-limited crewmembers
- FAA - No pilot >60
- Canada, Japan >63
- NZ, Australia - no limit
- ASMA Opinion 2004; “No medical evidence to support Age 60 Rule”
- Move to a 2% Rule shifts threshold

# Personal Strategies



- Age well and wisely
- Know yourself and your health
- Remain current
- Plan to avoid the unexpected
- Beware of delusions of adequacy
- Be aware of factors leading to “looming loss of compensation”