Australian Government
Civil Aviation Safety Authority

Ageing Pilots

Aviation Risk Management

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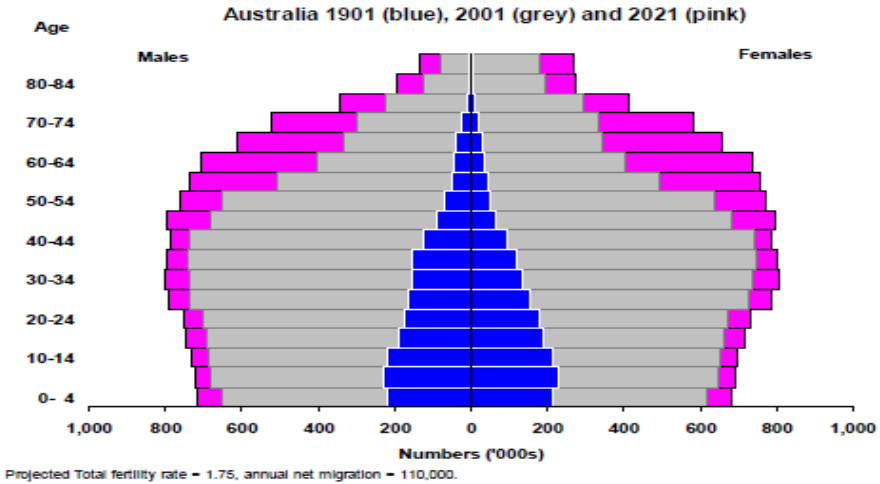
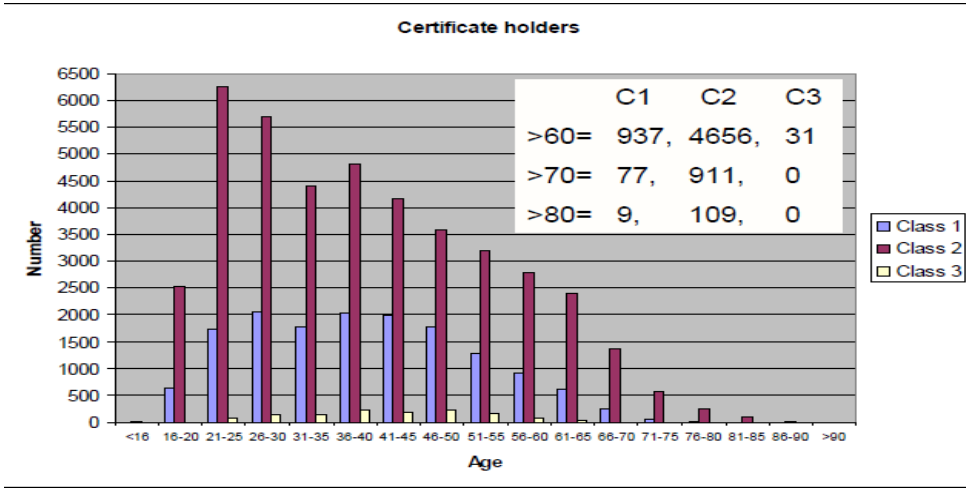
Scope of the issue





Aeromedical Significance

- Case series analysis of NTSB records of crashes 1983-2002
- Patterns of error similar across age groups
- The proportion of air taxi crashes that involved older pilots increased significantly with time
- Crashes among older pilots:
  - More likely during day
  - More likely off airport than on airport
  - No difference in fatal vs non fatal
  - Types of crashes not related to age
  - Prevalence of pilot error did not increase with age

SHORT COMMUNICATION

Pilot Age and Error in Air Taxi Crashes

GEORGE W. REBOK, YANDONG QIANG, SUSAN P. BAKER, AND GUOHUA LI

REBOK GW, QIANG Y, BAKER SP, LI G. *Pilot age and error in air taxi crashes.* Aviat Space Environ Med 2009; 80:647–51.

Introduction: The associations of pilot error with the type of flight operations and basic weather conditions are well documented. The correlation between pilot characteristics and error is less clear. This study aims to examine whether pilot age is associated with the prevalence and patterns of pilot error in air taxi crashes. ***Methods:*** Investigation reports from the National Transportation Safety Board for crashes involving non-scheduled Part 135 operations (i.e., air taxis) in the United States between 1983 and 2002 were reviewed to identify pilot error and other contributing factors. Crash circumstances and the presence and type of pilot error were analyzed in relation to pilot age using Chi-square tests. ***Results:*** Of the 1751 air taxi crashes studied, 28% resulted from mechanical failure, 25% from loss of control at landing or takeoff, 7% from visual flight rule conditions into instrument meteorological conditions, 7% from fuel starvation, 5% from taxiing, and 28% from other causes. Crashes among older pilots were more likely to occur during the daytime rather than at night and off airport than on airport. The patterns of pilot error in air taxi crashes were similar across age groups. Of the errors identified, 27% were flawed decisions, 26% were inattentiveness, 23% mishandled aircraft kinetics, 15% mishandled wind and/or runway conditions, and 11% were others. ***Conclusions:*** Pilot age is associated with crash circumstances but not with the prevalence and patterns of pilot error in air taxi crashes. Lack of age-related differences in pilot error may be attributable to the "safe worker effect."

Keywords: aging, air-taxi crashes, pilot error rates, safety.

THE EFFECTS OF aging on cognitive functions and piloting skills have been studied extensively. Research on pilots indicates that age-related declines are largely limited to domain-independent cognitive functions such as memory capacity and psychomotor skills. Domain-dependent cognitive functions that are directly related to flight tasks, such as decision making, tracking, takeoff, and landing, are less sensitive to aging effects (9,10). Among the few flight-related tasks that are found to decline with advancing age are abilities to respond to verbal communication (9,10) and time-sharing efficiency (11). Older pilots tend to perform worse than younger pilots in executing long and rapidly spoken air traffic control commands and in multitasking under conditions of increased attentional demands.

The findings from flight simulator based experimental studies of older pilots have not been well corroborated by epidemiologic evidence. It is unclear whether the prevalence and characteristics of pilot error differ with pilot age, though it is conceivable that pilots at different stages of cognitive aging may have different error propensity and make different types of error. Pilot error has been identified as a contributing factor in 85% of general aviation crashes and 68% of commercial aviation crashes (4). However, relatively little is known about age-related variations in pilot error. In a study of commuter and air-taxi pilots, Li et al. (5) reported that the prevalence and patterns of pilot error showed little change as pilots aged from the 40s into their 50s. However, that study was limited by its modest sample size (N = 165 crashes) and truncated age range (40–60 yr), which may have reduced the likelihood of finding significant age effects. In a recent study of pilot error in air carrier crashes involving Part 121 operations, Li et al. (6) found that the prevalence and patterns of pilot error in air carrier crashes do not appear to change with pilot age. However, the low prevalence rate of pilot error in air carrier crashes makes it difficult to fully assess age-related variation. The present study aims to examine the relationship between pilot age and error in a large case series of crashes by air taxis (non-scheduled Part 135 operations) that are known to be much more likely to involve pilot error than air carrier crashes (3). Based on our previous research on pilot aging and aviation safety, the goals of this study were twofold: 1) to investigate whether the prevalence of pilot error in air taxi crashes is associated with pilot age; and 2) to determine whether the type of pilot error in air taxi crashes varies with pilot age.

METHODS

The present study is a case series analysis of data for non-scheduled air taxi crashes recorded by the National Transportation Safety Board (NTSB) between 1983 and 2002. The NTSB data system is the official repository of investigation reports on all aviation crashes occurring within the United States, including its territories, possessions, and international waters. The NTSB is an independent federal agency charged by the U.S. Congress with investigating civil aviation crashes and major

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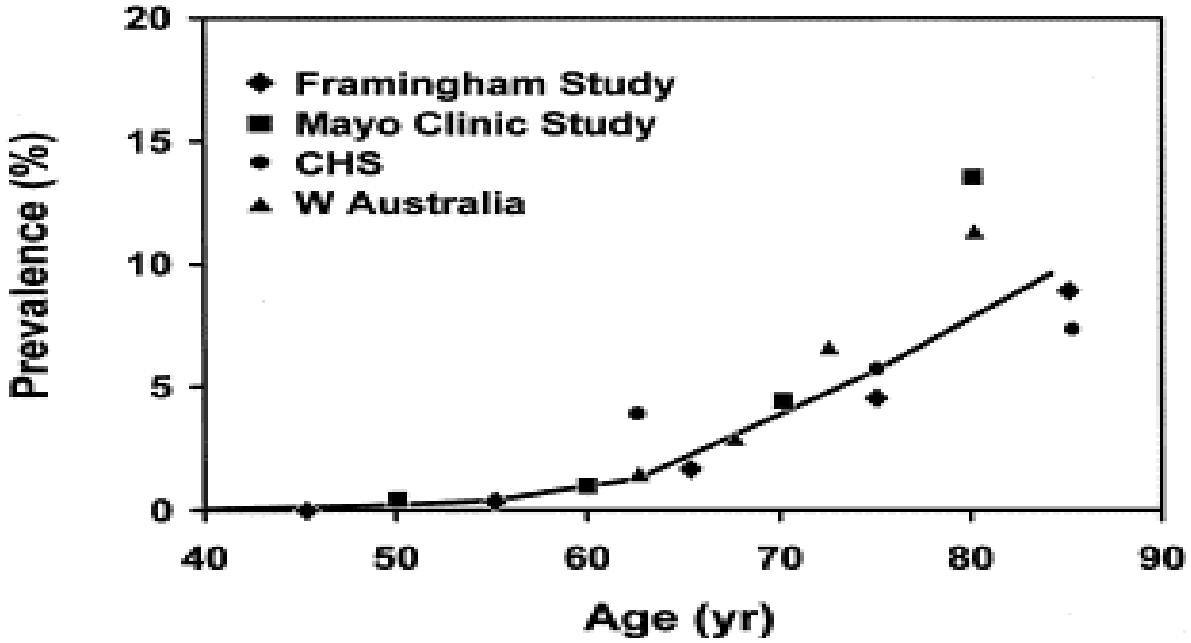
Age and Aviation

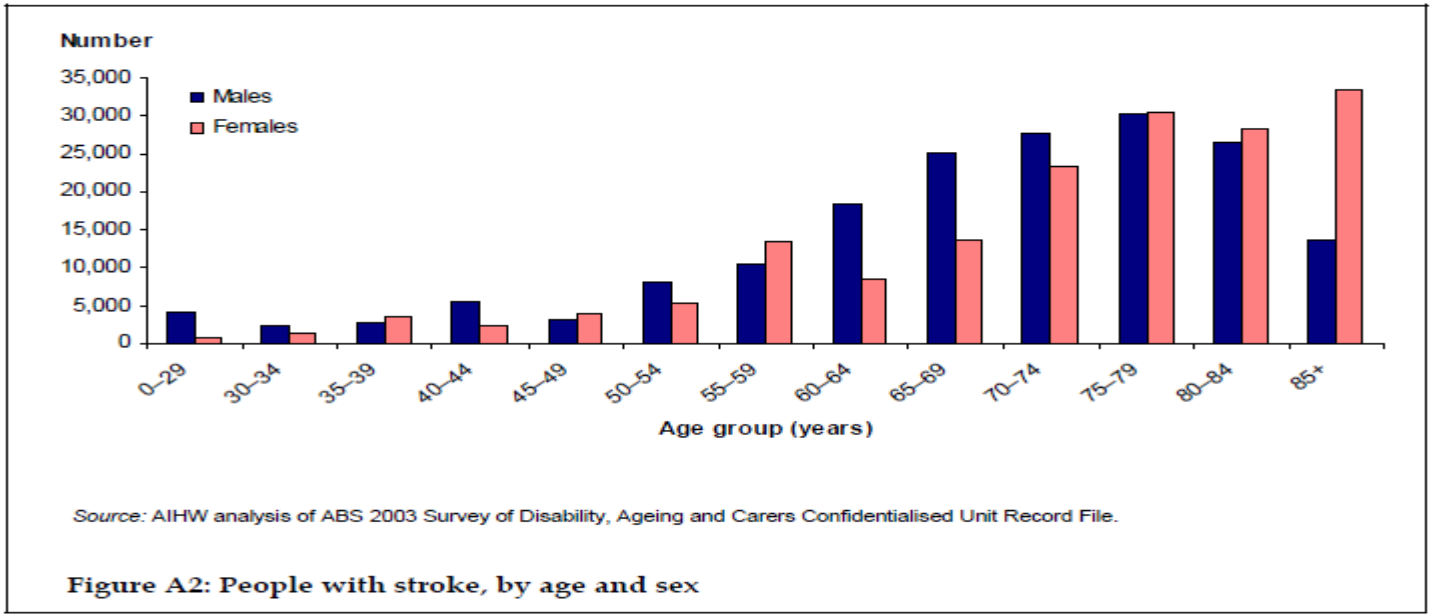
- Risk of safety relevant disease
  - Ischaemic Heart Disease
  - Atrial Fibrillation
  - Stroke
  - Cancer
  - Ophthalmological changes

Age and Aviation – Atrial Fibrillation



Likelihood of Clinical Event

Age and Aviation - Stroke

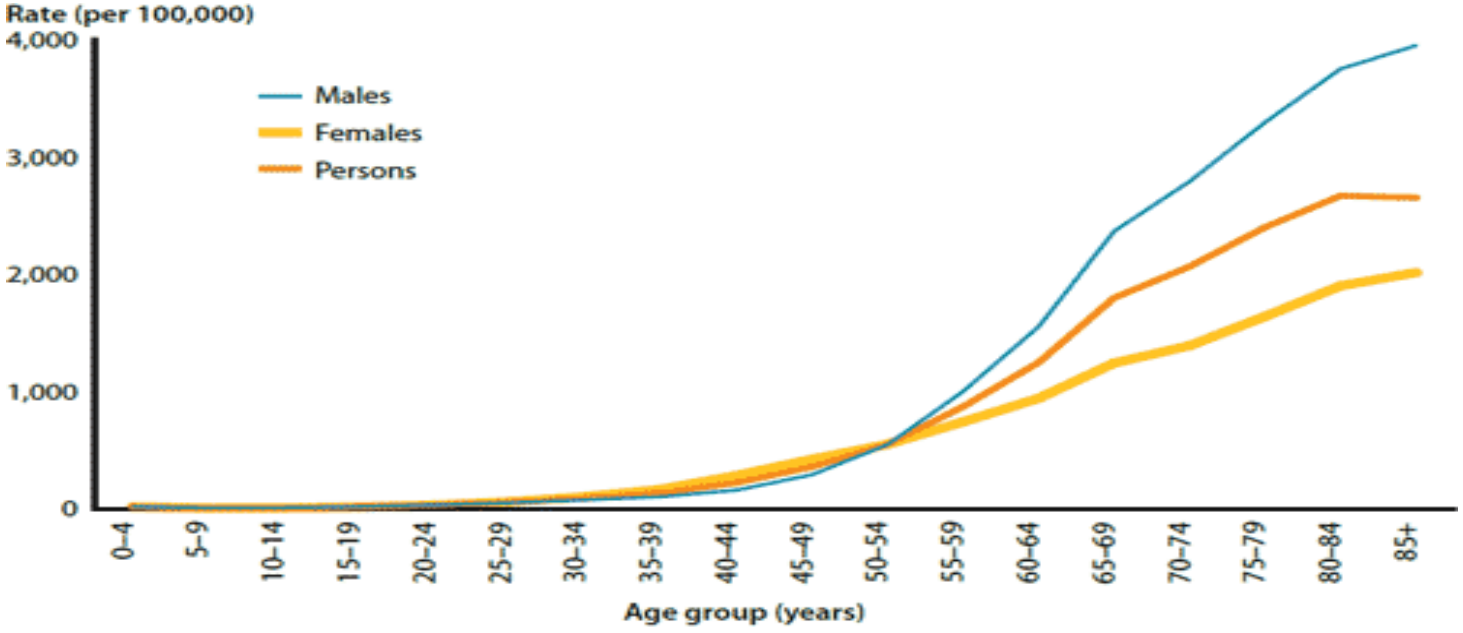


Source: AIHW analysis of ABS 2003 Survey of Disability, Ageing and Carers Confidentialised Unit Record File.

Figure A2: People with stroke, by age and sex

Likelihood of Clinical Event

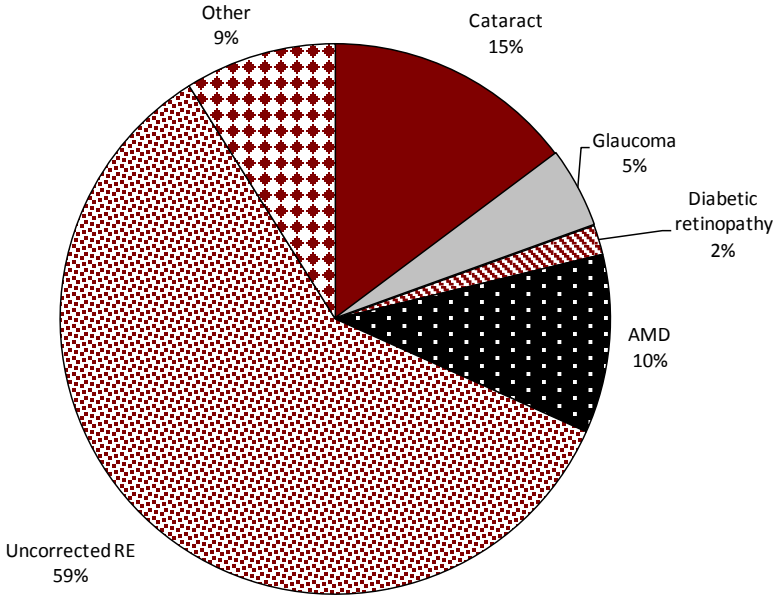
Age and Aviation - Cancer



Likelihood of Clinical Event

Age and Aviation – Eye disease

- Vision loss by cause ages 40+ years

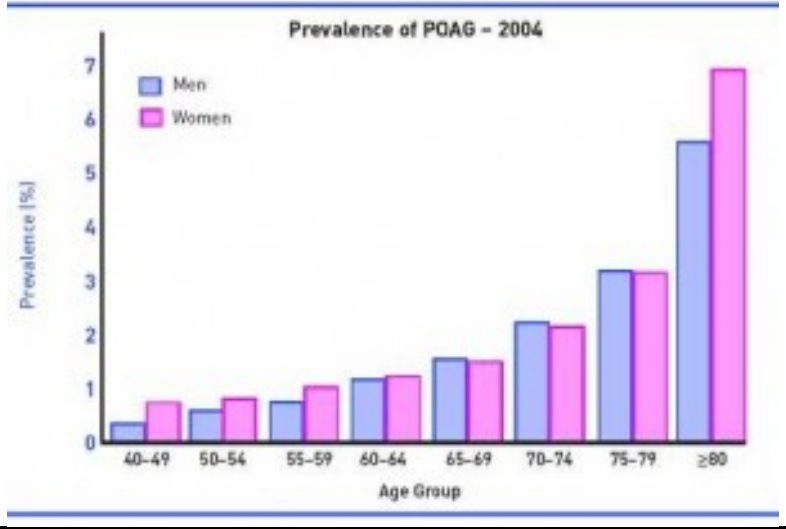


Likelihood of Clinical Event

Age and Aviation – Eye disease

- Glaucoma incidence

- Among Australians >55 years of age:
  - the prevalence of open-angle glaucoma is approximately 2.3%
  - 8% of cases of vision impairment are due to glaucoma
  - 16% of cases of blindness are due to glaucoma.[4]



Likelihood of Clinical Event

Age and Aviation

- Cognitive decline
  - Can begin very early, from 40 years of age
  - Varies across individuals
  - May be partly related to medical issues
  - Executive functions are the earliest ones to be impacted by ageing and are considered crucial to aviation
    - Underlie goal-directed behaviour and adaptation to novel and complex situations, decision marking etc
  - Cognitive decline represents a much higher accident risk than a sudden physical incapacitation (Schroeder et al 2000)
  - Experience

Studies of Cognition, Age and Aviation

- Evaluated EFs and linked their efficiency to flight navigation performance and decision making
- 32 Private Pilots
- Take off, navigate, calculate, land, failure of compass
- Measured neuropsychiatric (declined with age) and fight performance
- Found that age effect on performance was mediated by cognitive performance decline

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Psychology Press

Cognitive aging and flight performances in general aviation pilots

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ABSTRACT

Unlike professional pilots who are limited by the FAA's age rule, no age limit is defined in general aviation. Our overall goal was to examine how age-related cognitive decline impacts piloting performance and weather-related decision-making. This study relied on three components: cognitive assessment (in particular executive functioning), pilot characteristics (age and flight experience), and flight performance. The results suggest that in comparison to chronological age, cognitive assessment is a better criterion to predict the flight performance, in particular because of the inter-individual variability of aging impact on cognitive abilities and the beneficial effect of flight experience.

Keywords: Aging; Executive functions; Aviation; Human factors; Decision making.

The population of general aviation (GA) pilots is getting older in the USA (Hardy & Parasuraman, 1997) and in European countries like France where 41% of private pilots are more than 50 years old (BEA,[1] 2000). Unlike professional pilots who are limited by the FAA's "age 65" rule, no such restriction exists for GA pilots. It is worth examining how age-related cognitive decline may impact piloting performance in GA.

[1] French Accident Investigation Bureau.

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Likelihood of Aviation Event

Tests of Cognitive Function

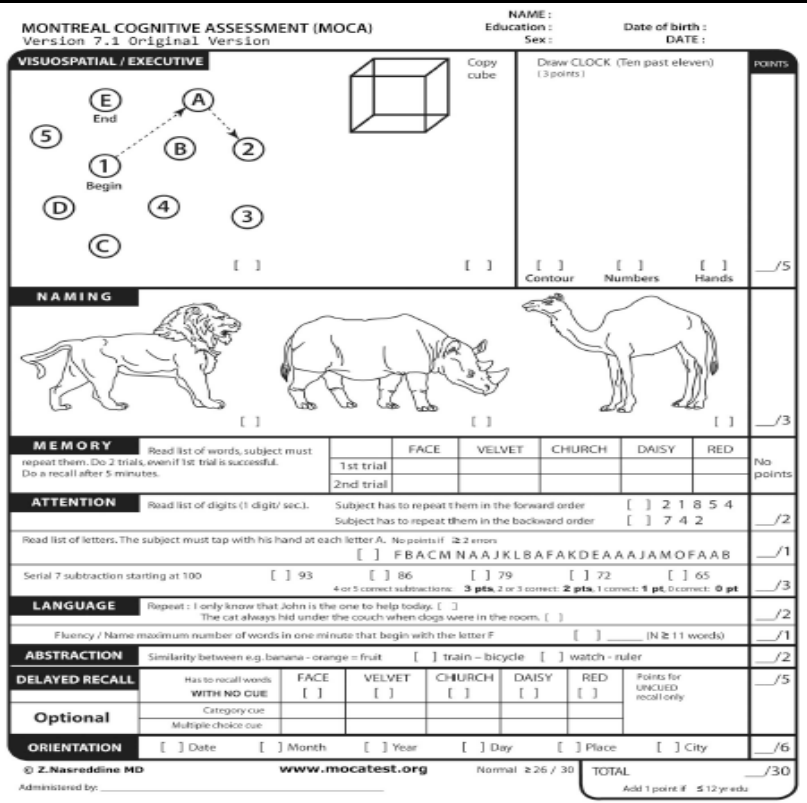
- Cogscreen-AE
  - computer-administered and scored cognitive-screening instrument designed to rapidly assess deficits or changes in attention, immediate- and short-term memory, visual perceptual functions, sequencing functions, logical problem solving, calculation skills, reaction time, simultaneous information processing abilities, and executive functions

COGSCREEN®
AEROMEDICAL EDITION

- Designed for for use in the medical re certification evaluation of pilots with known or suspected neurological and/or psychiatric conditions
- Cost ~ $35 USD / test
- About 50 min to complete

Tests of Cognitive Function

- Montreal Cognitve Assessment (MoCA)
- 7-10 mins
- Free



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

NAME :
Education :
Sex :
Date of birth :
DATE :

VISUOSPATIAL / EXECUTIVE — Copy cube — Draw CLOCK (Ten past eleven) (3 points) — POINTS /5
Contour [ ] Numbers [ ] Hands [ ]

NAMING — /3

MEMORY — Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.
FACE VELVET CHURCH DAISY RED
1st trial
2nd trial
No points

ATTENTION — Read list of digits (1 digit/ sec.). — /2
Subject has to repeat them in the forward order [ ] 2 1 8 5 4
Subject has to repeat them in the backward order [ ] 7 4 2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors — /1
[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

Serial 7 subtraction starting at 100 — /3
[ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65
4 or 5 correct subtractions: 3 pts, 2 or 3 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt

LANGUAGE — Repeat : I only know that John is the one to help today. [ ] — /2
The cat always hid under the couch when dogs were in the room. [ ]

Fluency / Name maximum number of words in one minute that begin with the letter F — /1
[ ] _____ (N ≥ 11 words)

ABSTRACTION — Similarity between e.g. banana - orange = fruit — /2
[ ] train – bicycle [ ] watch - ruler

DELAYED RECALL — /5
FACE VELVET CHURCH DAISY RED
Has to recall words WITH NO CUE [ ] [ ] [ ] [ ] [ ]
Points for UNCUED recall only
Optional: Category cue / Multiple choice cue

ORIENTATION — /6
[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

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TOTAL /30
Add 1 point if ≤ 12 yr edu
Administered by: _____

CASA Paradigm

- More intensive testing for PPLs over age 60
- (ATPL and CPL Class 1 already require regular screening for cardiovascular, eye disease)

CASA Paradigm

- For ageing, the methods should be commenced at 65, and repeated at 67, 69, and 71. Thereafter they should be annual.
  - Cognition should be assessed by a paper and pencil test (MoCA) AND a flight test, and the two assessed together.
  - CAD should be assessed at 65, and 70, and 5 yearly thereafter, by a stress ECG.

    DAMEs should have a high index of suspicion for AF after 65.
  - Eye exams should be mandated at 65 and 5 yearly thereafter
    Interval eye exams by DAMEs should have some advisory material provided so as to improve sensitivity.
  - Periodicity of medical examinations after 70 should be annual.

Questions?