Age and psychological fitness

evaluation of train driver psychometric test results

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Background – psychological testing

- Observation: more unfit participants over the age of 50
- Theoretical correlation with age
- Problem of increased retirement age
- Observed key factors:
  - reaction time*
  - reaction to complex stimuli (ability to decide)*
  - hand tremor**
  - visual memory**

- *Researches identified RT and complex RT tasks as valid predictors for fitness (Ferreira; Simões; Marôco, 2013)
- **Based on our empirical experience. After consultation to our colleagues it came clear the abilities above are the most critical during fitness decision making at certain age groups.

Background – age and driving

- Difficulties
  - Distance / lateral inconsistency (following / lanes)
  - Greater perceived mental demand (normal: 50 % spare to expect critical situations) (Bunce; Young; Blane; Khugputh, 2012)
  - Longer reaction to additional tasks in complex scenario (Stinchcombe; Gagnon, 2012)

Psychological examinations in Hungary (VE)

- Monotony tolerance
- Concentration
- Optomotoric coordination
- Visual memory
  - (positioning characters after 500 msec exposure)
- Divided attention
- Precision
- Vegetative stress parameters (hand tremor)

- FPI (Freiburg Personality Inventory - 12 factors)
  - psychosomatic symptoms
  - depression
  - agression
  - frustration tolerance
  - neurotical disorder
  - extroversion
  - etc.
- Additional clinical tests (optional!)
- Personal interview

Hypothesis

Over the age of 50 years performance drops significantly in factors:

- Reaction time
- Adequate reaction to complex stimuli (ability to decide)
- Hand tremor
- Visual memory

- (…or at least 2 of these factors)

Expectation: function slope shows breakpoint (downturn) between age 50 and 55

Sample

- 200 participants (train drivers)
- age min.: 20 / age max: 60
- previously examined
  - at least 2 evaluations
  - exclude new applicants with high result variance
- 14 groups by age category
  - (3 years / group)

- Examination datas used:
  - **Senso** - reaction time (msec)
  - **Senso** - failures (missed stimuli)
  - **Distributive** - performance
  - **Distributive** - failures (missed stimuli)
  - **Tachistoscope** - performance % (correct answers)
  - **Hand tremor** - number of hand movements over limit
  - Auxiliary scales: **FPI**
    - psychosomatic symptoms
    - depression
    - neurotic tendency

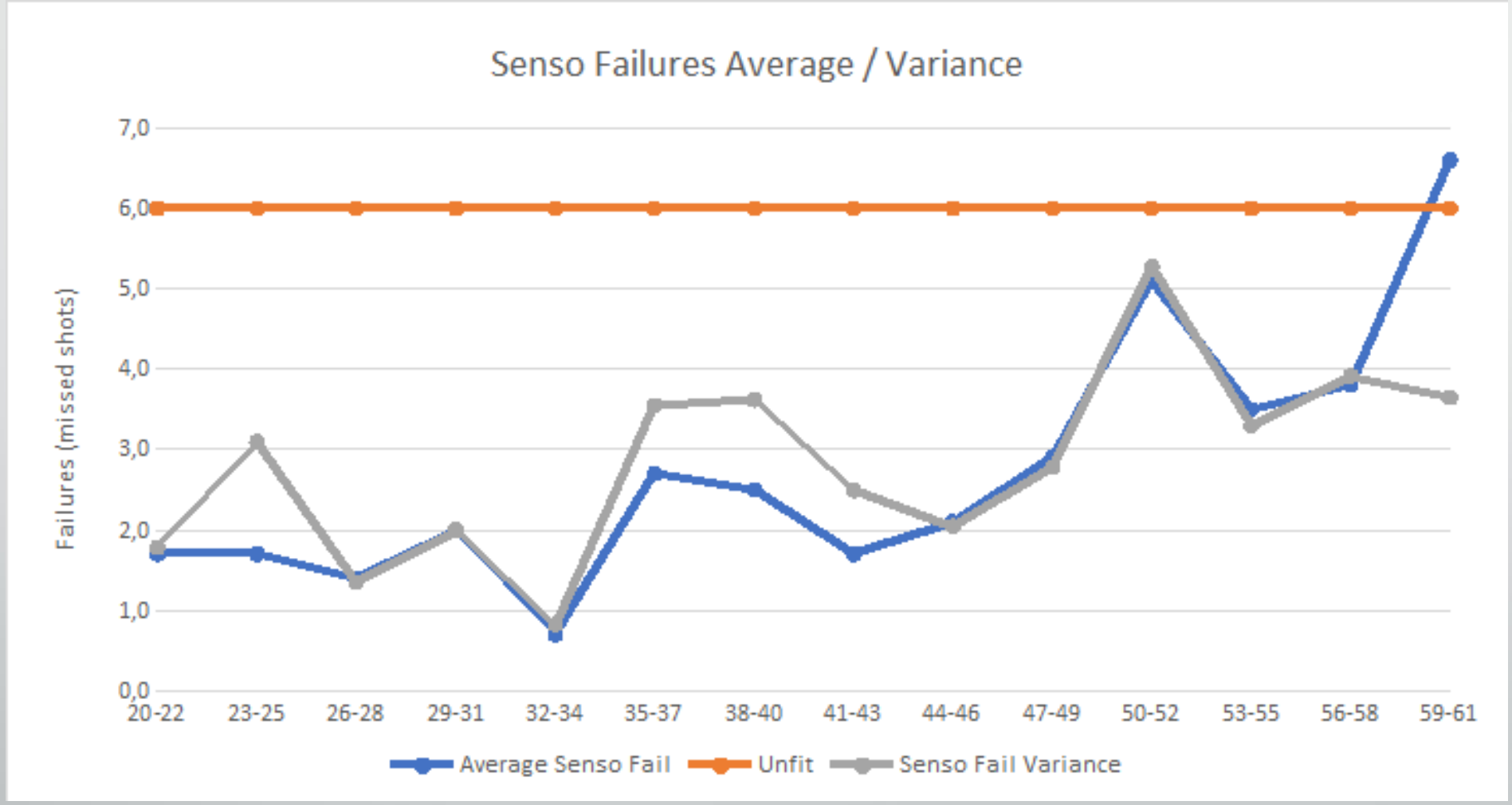
Data analysis

- Calculating the average value at each group
- Calculating variance at each group
  - High variance
    - increasing eventuality
    - uncertainty of personal performance
    - need of restricted regular examination and personal evaluation / fitness decision
  - Low variance
    - higher correlation of performance drop with age
    - need of comprehensive solution / prevention

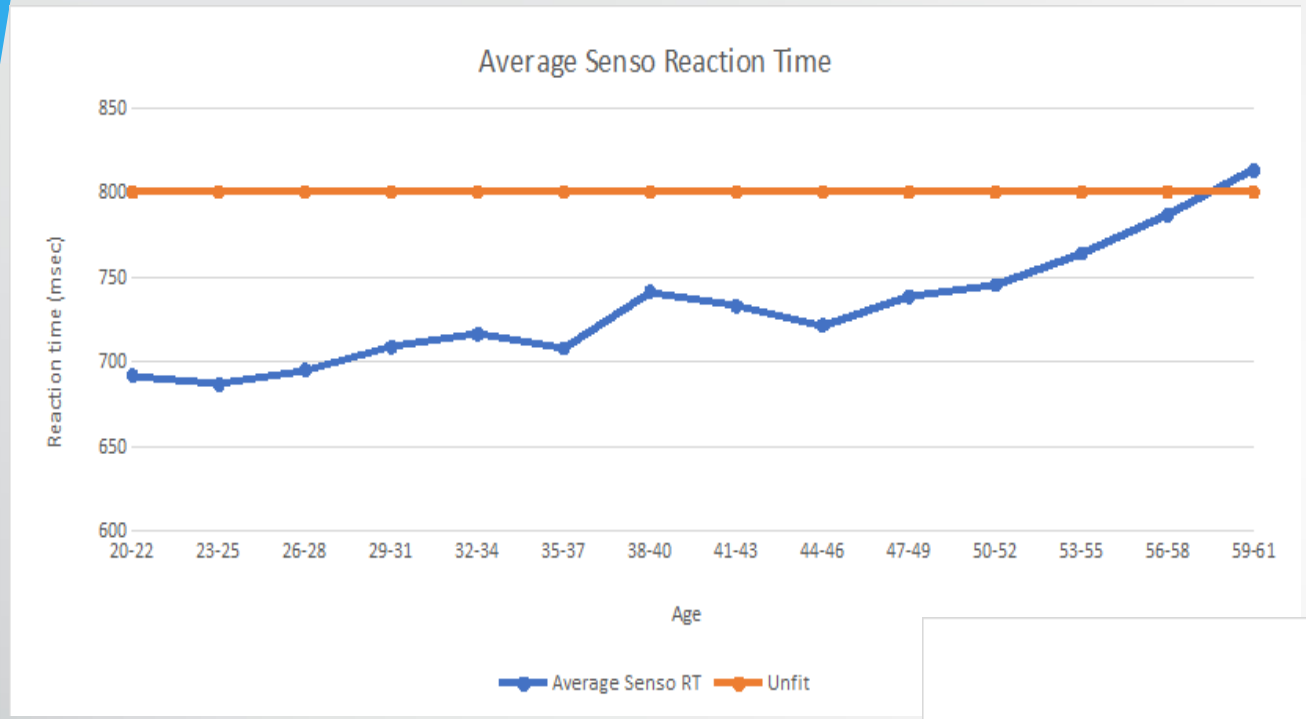
Results

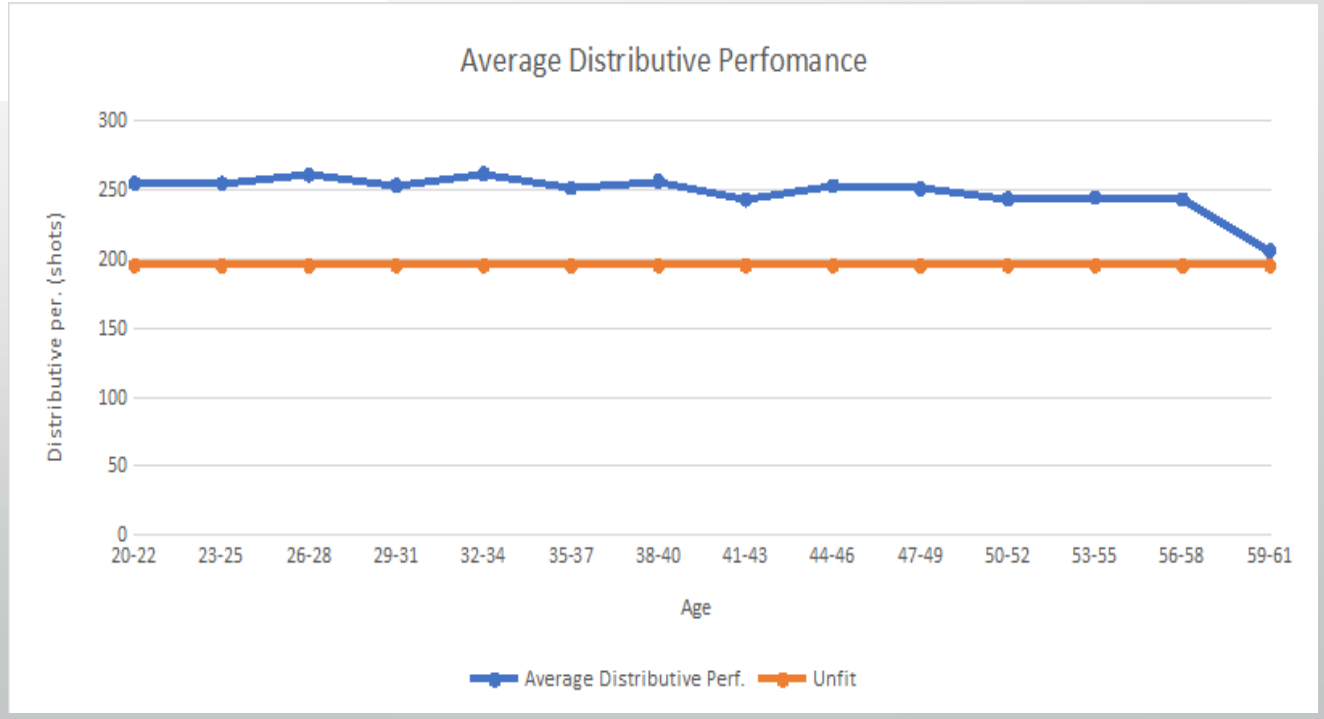
- Senso - reaction time (msec)
  - **True**
  - low variance
  - from age 50
- Senso - failures (missed stimuli)
  - **True**
  - from age 56-58
- Distributive – performance
  - **tendency***
  - low variance (sudden over age 56-58)
  - *on the edge
- Tachistoscope - performance %
  - **tendency only** + high variance
- FPI psychosomatic symptoms
  - **tendency only** + high variation

Results

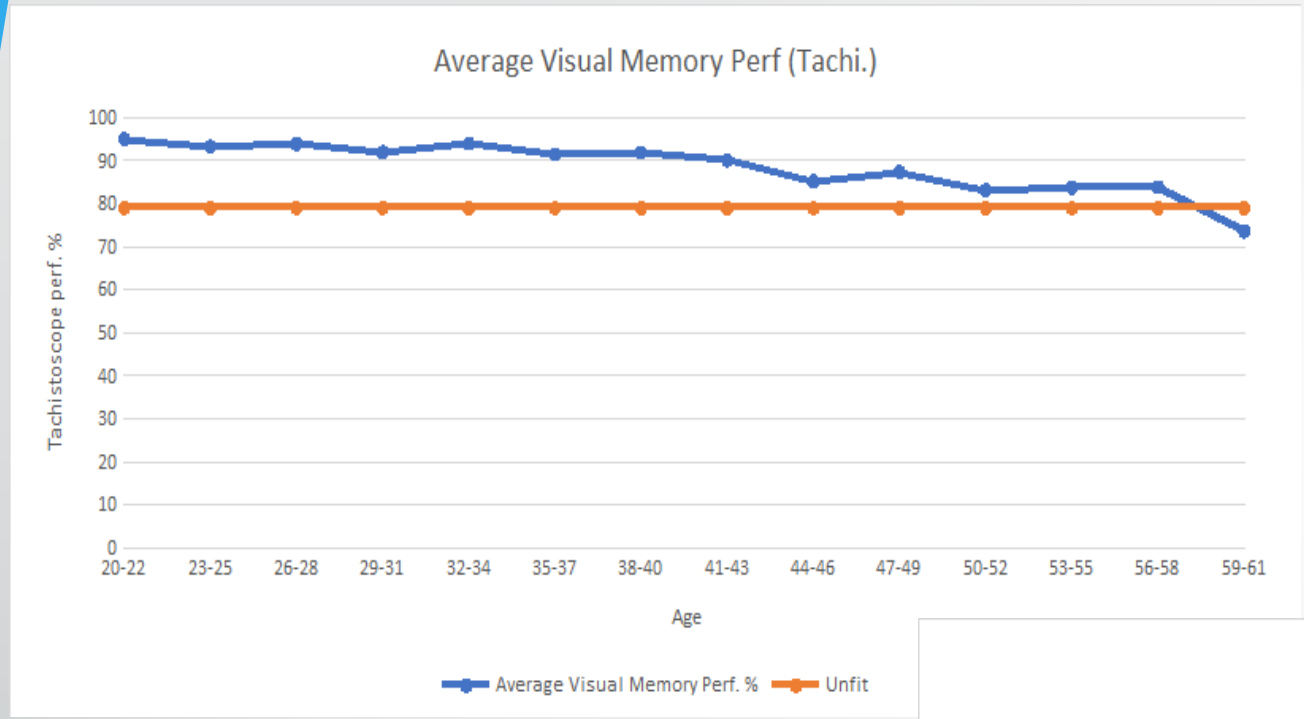

Senso Failures Average / Variance
Failures (missed shots)
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
20-22
23-25
26-28
29-31
32-34
35-37
38-40
41-43
44-46
47-49
50-52
53-55
56-58
59-61
Average Senso Fail
Unfit
Senso Fail Variance

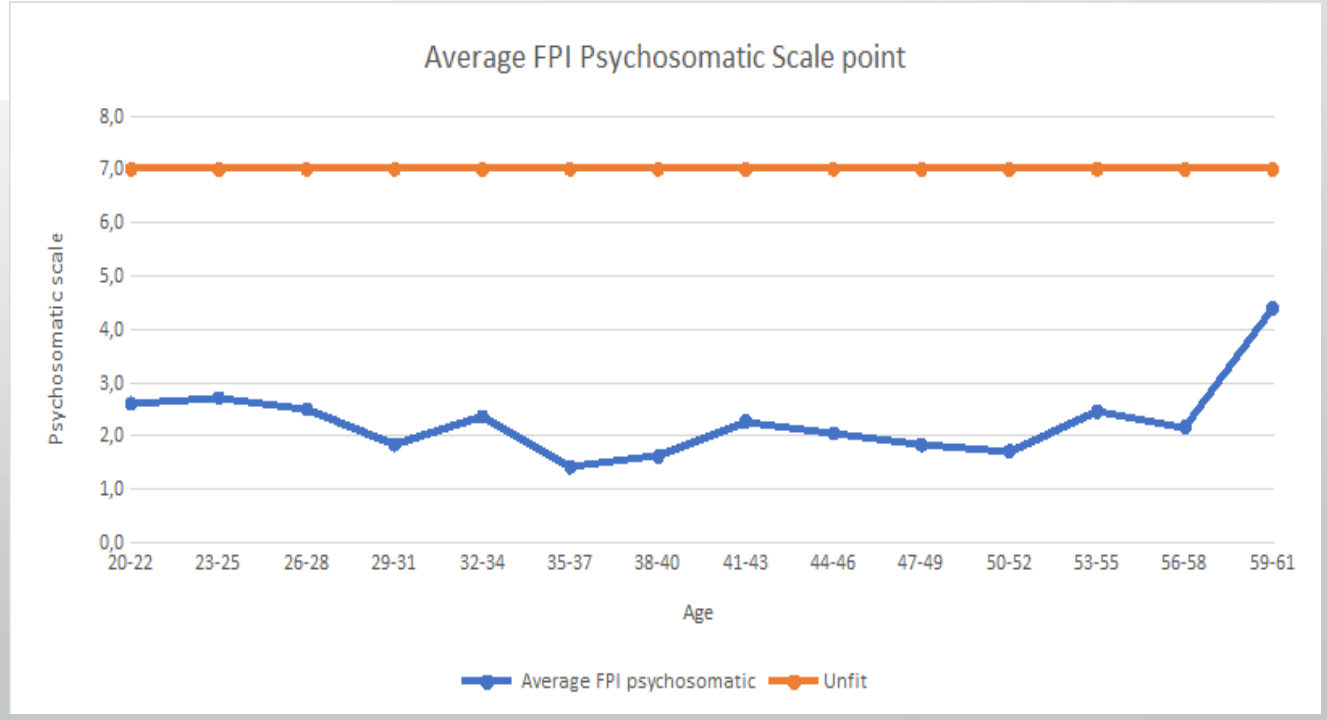
Results


Average Senso Reaction Time
850
800
750
700
650
600
Reaction time (msec)
20-22
23-25
26-28
29-31
32-34
35-37
38-40
41-43
44-46
47-49
50-52
53-55
56-58
59-61
Age
Average Senso RT
Unfit


Average Distributive Perfomance
300
250
200
150
100
50
0
Distributive per. (shots)
20-22
23-25
26-28
29-31
32-34
35-37
38-40
41-43
44-46
47-49
50-52
53-55
56-58
59-61
Age
Average Distributive Perf.
Unfit

Results


Average Visual Memory Perf (Tachi.)
Tachistoscope perf. %
100
90
80
70
60
50
40
30
20
10
0
20-22
23-25
26-28
29-31
32-34
35-37
38-40
41-43
44-46
47-49
50-52
53-55
56-58
59-61
Age
Average Visual Memory Perf. %
Unfit


Average FPI Psychosomatic Scale point
Psychosomatic scale
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
20-22
23-25
26-28
29-31
32-34
35-37
38-40
41-43
44-46
47-49
50-52
53-55
56-58
59-61
Age
Average FPI psychosomatic
Unfit

Discussion

- Above age 50
  - higher reaction time
- Above age 55
  - handling failures (missed operational answers)
  - incidental variability of visual memory
    - (as very short – exposured stimuli, the latter may correlate with RT at Senso)
- FPI psychosomatic scale: higher scores
  - overall being perception decrease from age 56-58
  - personal interviews: possible correlation with
    - long term fatigue
    - frequent day and night shift combination
    - obligate attention behaviour.

Discussion

- Higher complexity of stimuli = lower performance in critical age groups.
- Suggestion to exclude unfit conditions
  - over 50: 2 years periodical aptitude testing*
  - over 55: 1 year periodical aptitude testing*

Over 55 very few train drivers can fit the requirements of safe train driving. Most of them will face the lack of quick respond in critical situations combined with inadequate motoric actions. These skills are essential to prevent accidents.

*every second evaluation should be advisory only – let the applicant see the personal tendency of performance

Discussion - further aspects

- Use tendencies as prevention tool
  - Selecting duty categories – more personal?
  - Personal development
    - decision AND support
  - Outplacement
- Suitability control
  - Low performance = unsafe driving?
  - Rarely focused by researches

High speed / normal fast train environment

- Fast changing physical environment
- Outside signals (particularly in low visibility / night conditions)
- Unexpected signs, warnings from instrument panel
- Automation (solution?): not as affective as expected

Typical example

- Failure in traction motors
- Small sign on left hand screen
- Needs reaction / answer ASAP to prevent destruction of engine (pressing adequate buttons on screen)
- Distraction of attention!

Shunting locomotives – station environment risk factors

- Frequent change of movements, surrounded with ground staff members and objects;
- Limited space for movements;
- Limited visual control
- Radio and remote controlled processes: limited information base – higher time pressure.

Branch line – more ideal

- Lower traffic density
- Lower environment density / less visual objects at same time
- Lower speed / lower time pressure
- More space and time (physical and mental) for decisions and actions
- Lower fatigue (due to lower level of obligate attention)

Thank You!

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