



European  
Research  
Council



# The Cognitive Changes in Ageing Dogs

ENIKO KUBINYI

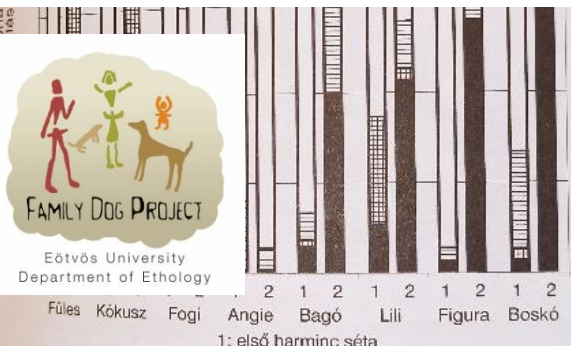
Professor

Department of Ethology, ELTE  
Eotvos Lorand University

Budapest, Hungary



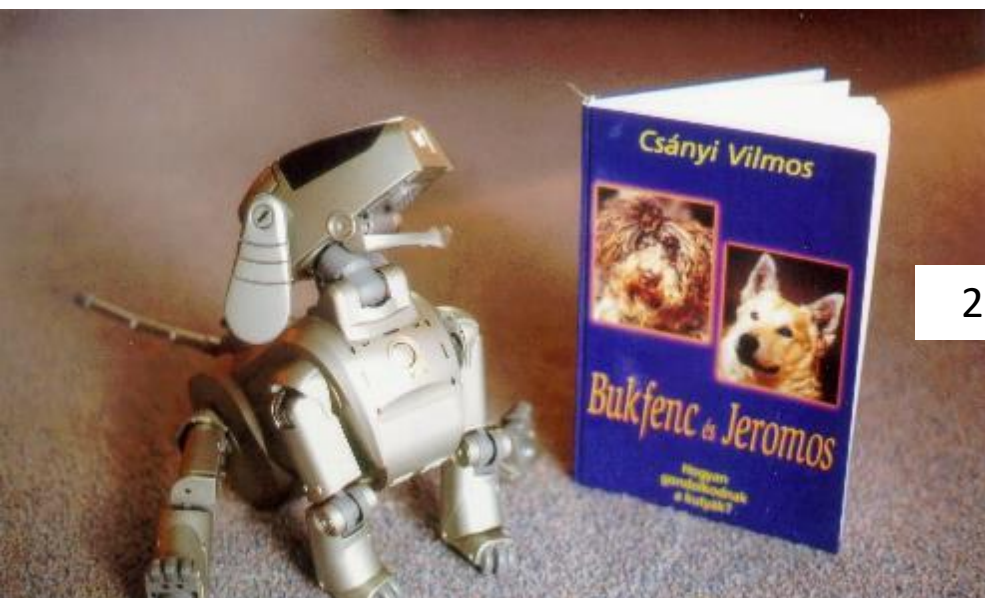
1994: Joining the Family Dog Project; social learning



Vilmos Csányi, Ádám Miklósi  
József Topál, Antal Dóka



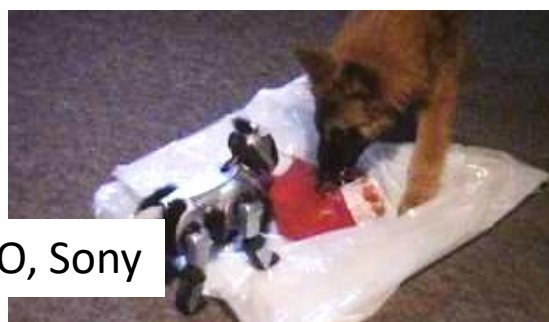
2001: Wolf hand-raising, comparative cognition



2001: AIBO, Sony



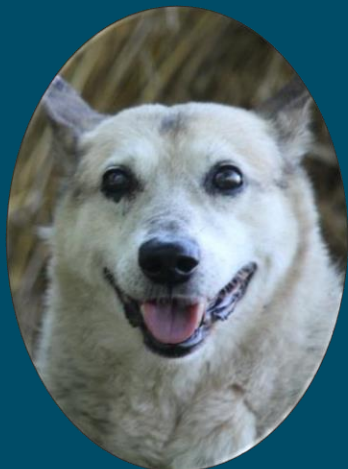
2010: Behaviour genetics, personality



2016: Cognitive ageing



*What is the biggest disadvantage of dog*



Buksi (27)



Bobi (31)



french bulldog  
(4.5)



great Dane  
(6.5)

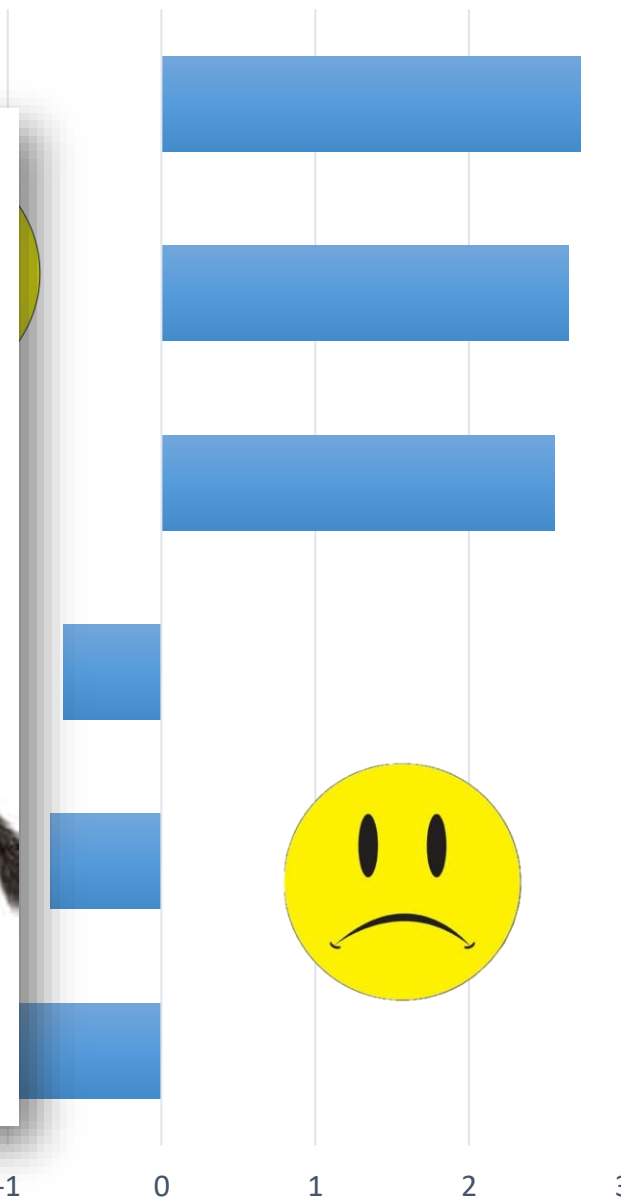


Gillet, in prep, N=457

average: 13 years  
(increased 4 years in 3 decades)

3/32

make life more cheerful





# MILLIONAIRE

What percentage of the European population is over 65?

Earth

Europe

2022

A:

9

B:

20

2022

2050

C:

21

D:

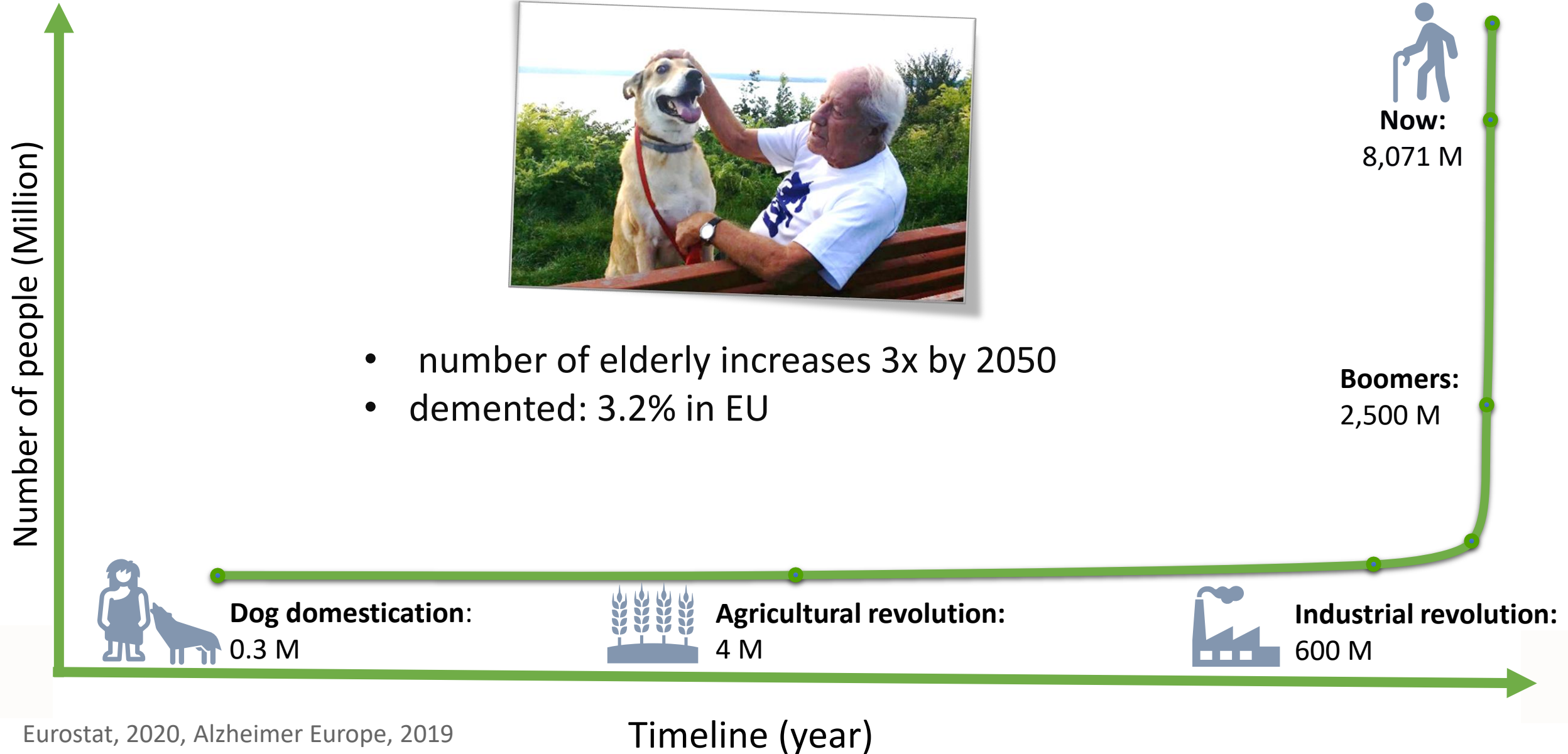
29

2050

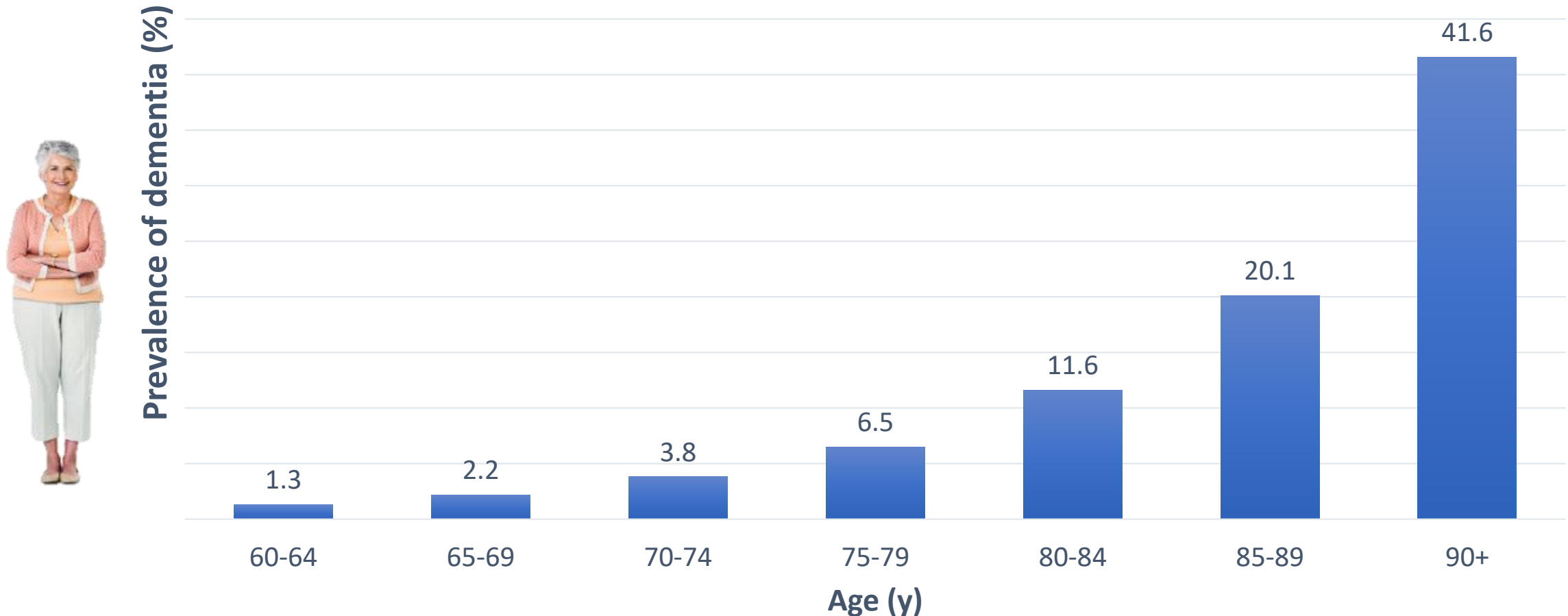
# Global problem: Ageing society



- number of elderly increases 3x by 2050
- demented: 3.2% in EU

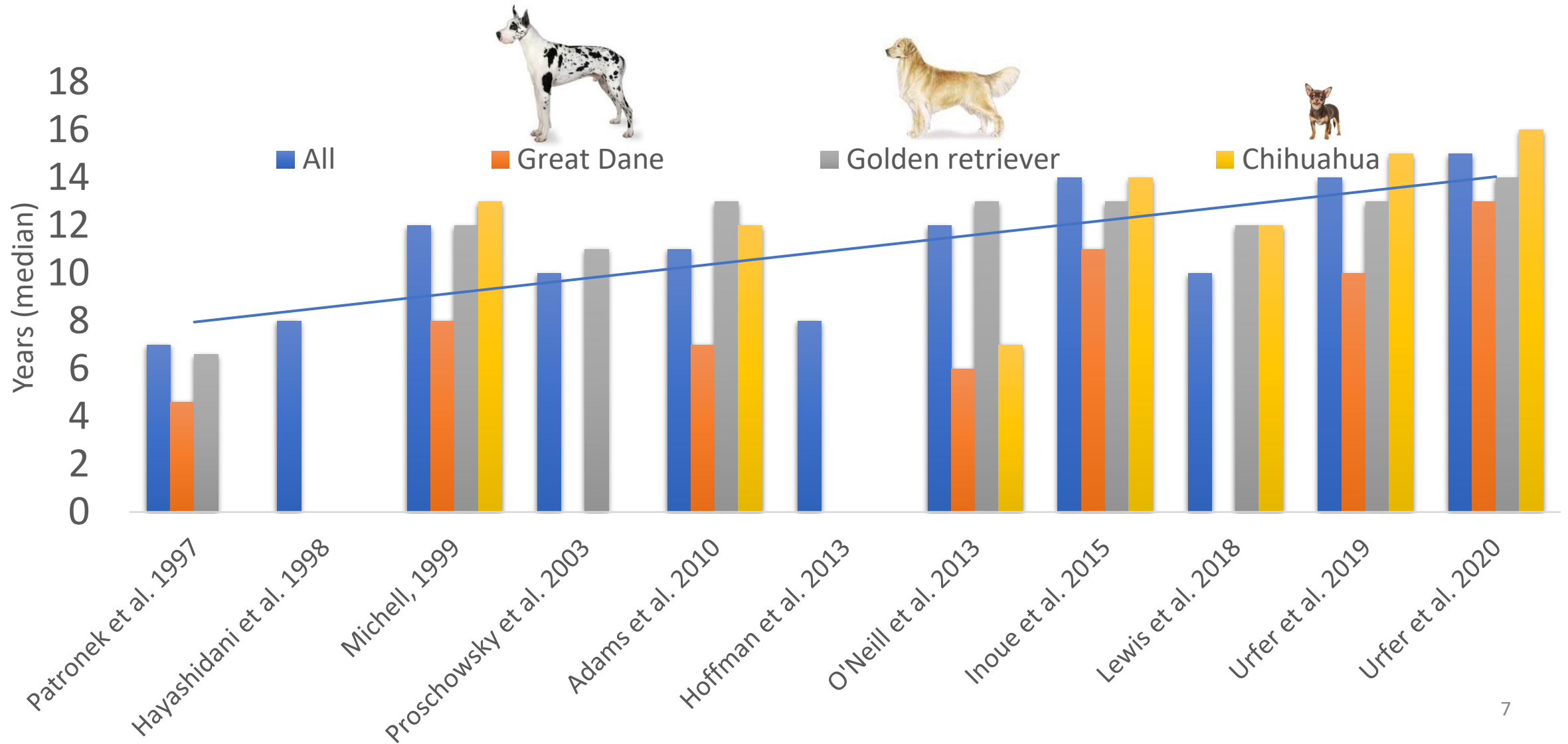


- onset of dementia: 60 years
- prevalence increases with age
- number of demented patients doubles in 20 years



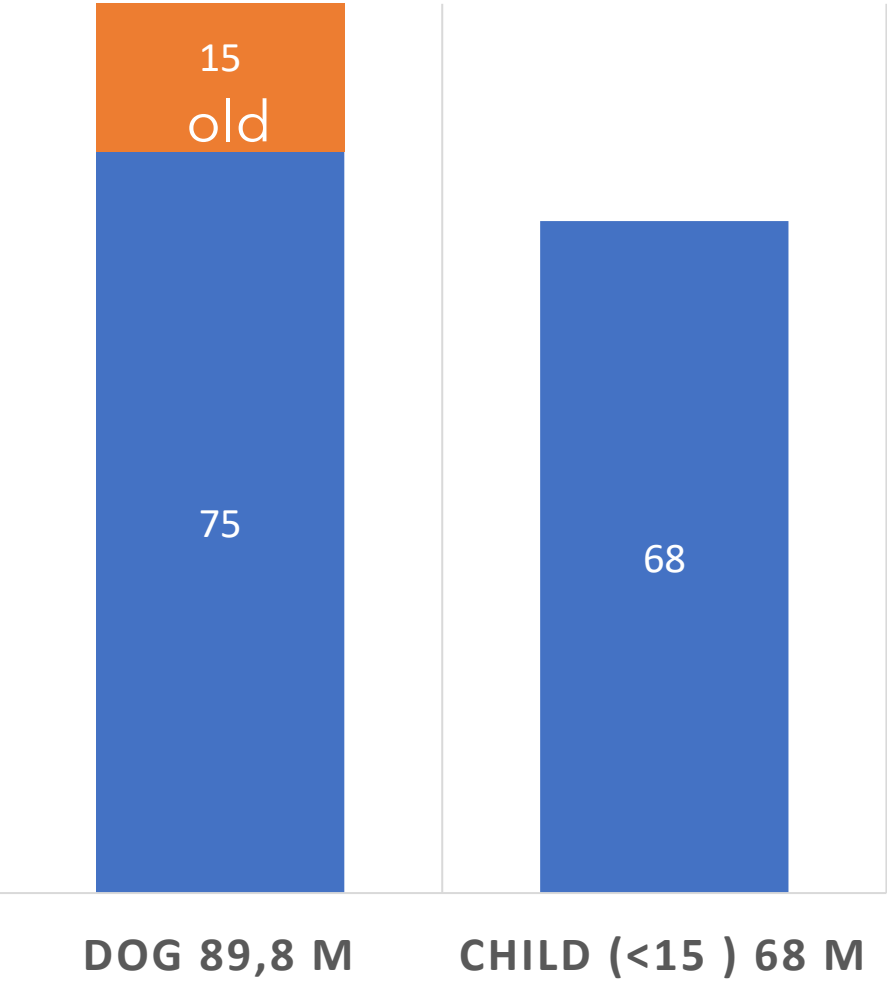
## Similarities with pet dogs:

- dogs also live longer in the last 2-3 decades
- number of old dogs, incl. "demented" increased





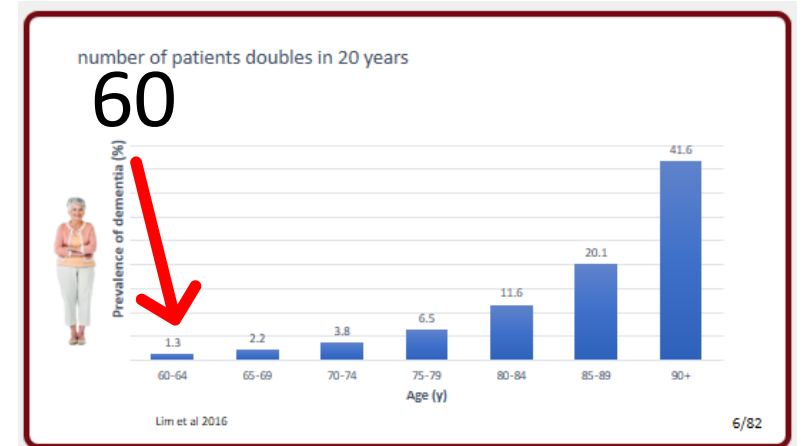
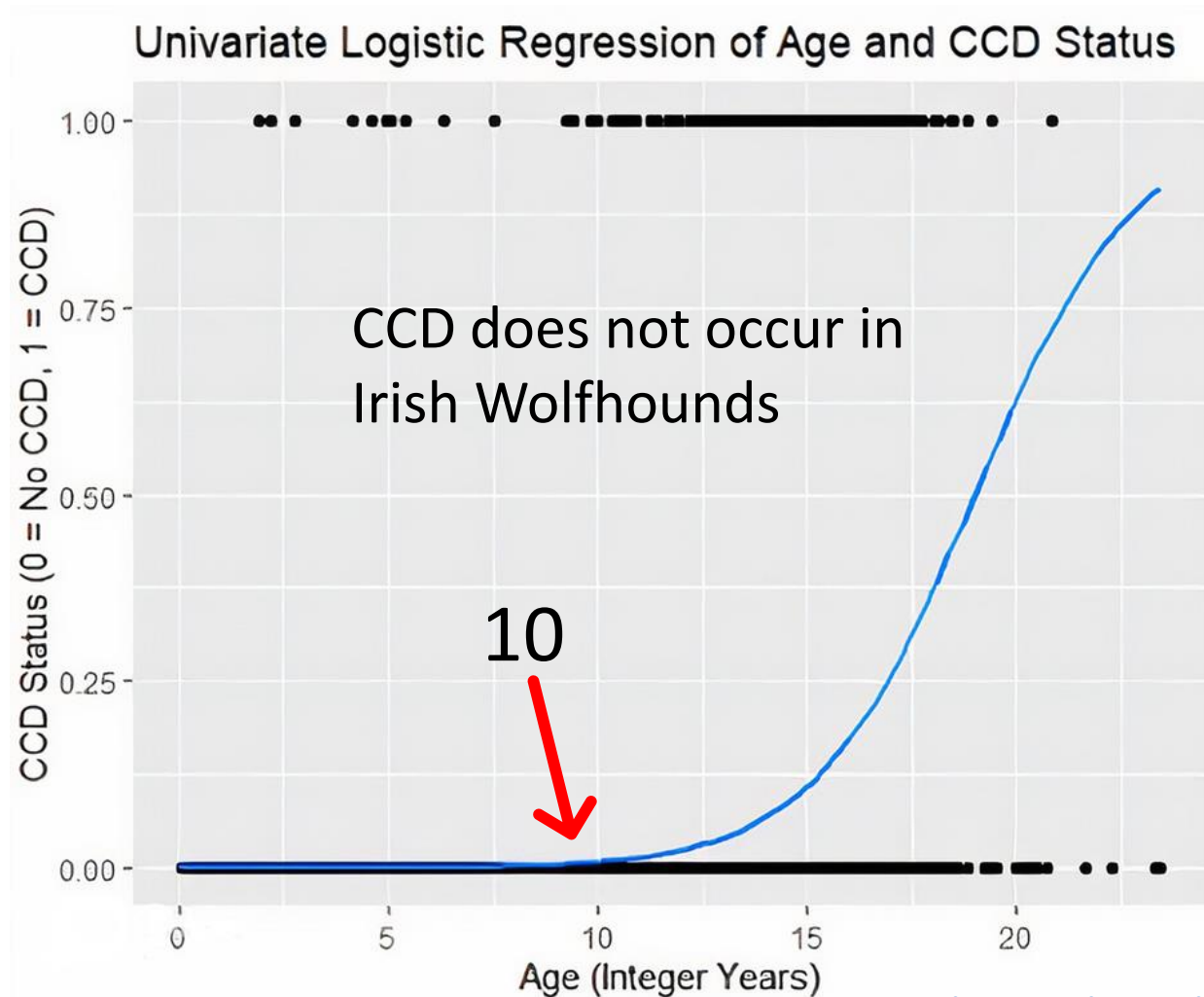
# There are more dogs than children in Europe (and in the USA, too)



Molnár Csaba



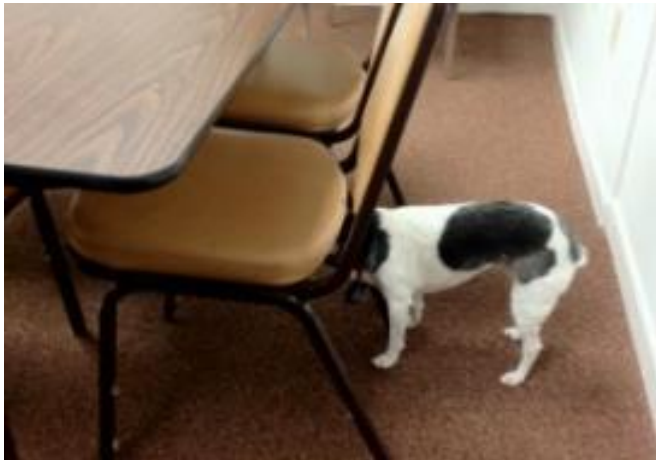
- onset of canine "dementia" (canine cognitive dysfunctions - CCD): **10 years**
- the longer a dog lives, the greater the chance that it will develop CCD



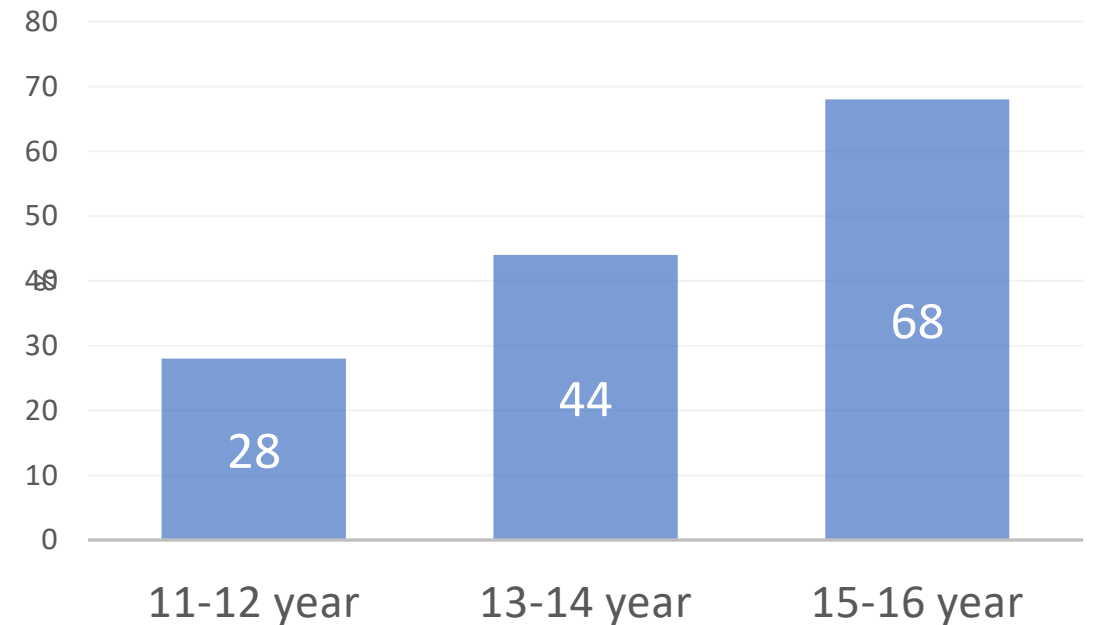
# Canine "dementia": *canine cognitive dysfunction* (CCD)



<https://www.youtube.com/watch?v=92dUQZzRbGw>, dogdementia.com




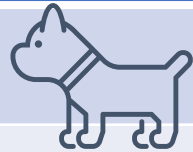
At least 1 symptom of the Canine Cognitive Dysfunction



- spatial disorientation, social dysfunction, incontinence, sleep-awake cycle



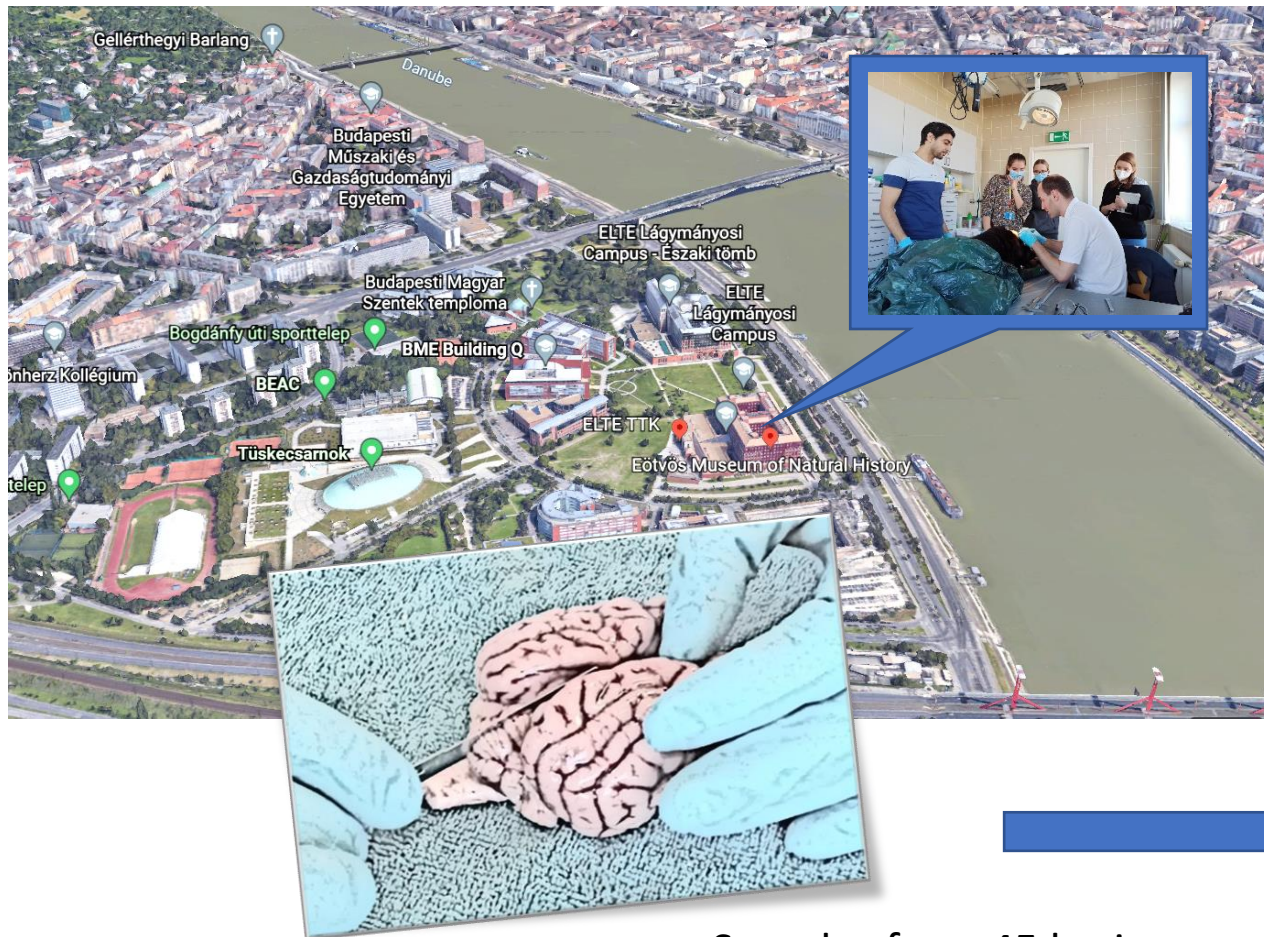
# Similarities between human and dog "dementia"

Human dementia	Canine "dementia"
 speech impairment	
memory loss	✓
confusion, spatial disorientation	✓
mobility problems	✓
irritability, anxiety	✓
sleep wake cycle disruption	✓
hallucinations	✓
incontinence	✓
60-70%: Alzheimer's disease (A $\beta$ 42)	???

# The molecular background of “dog-dementia”

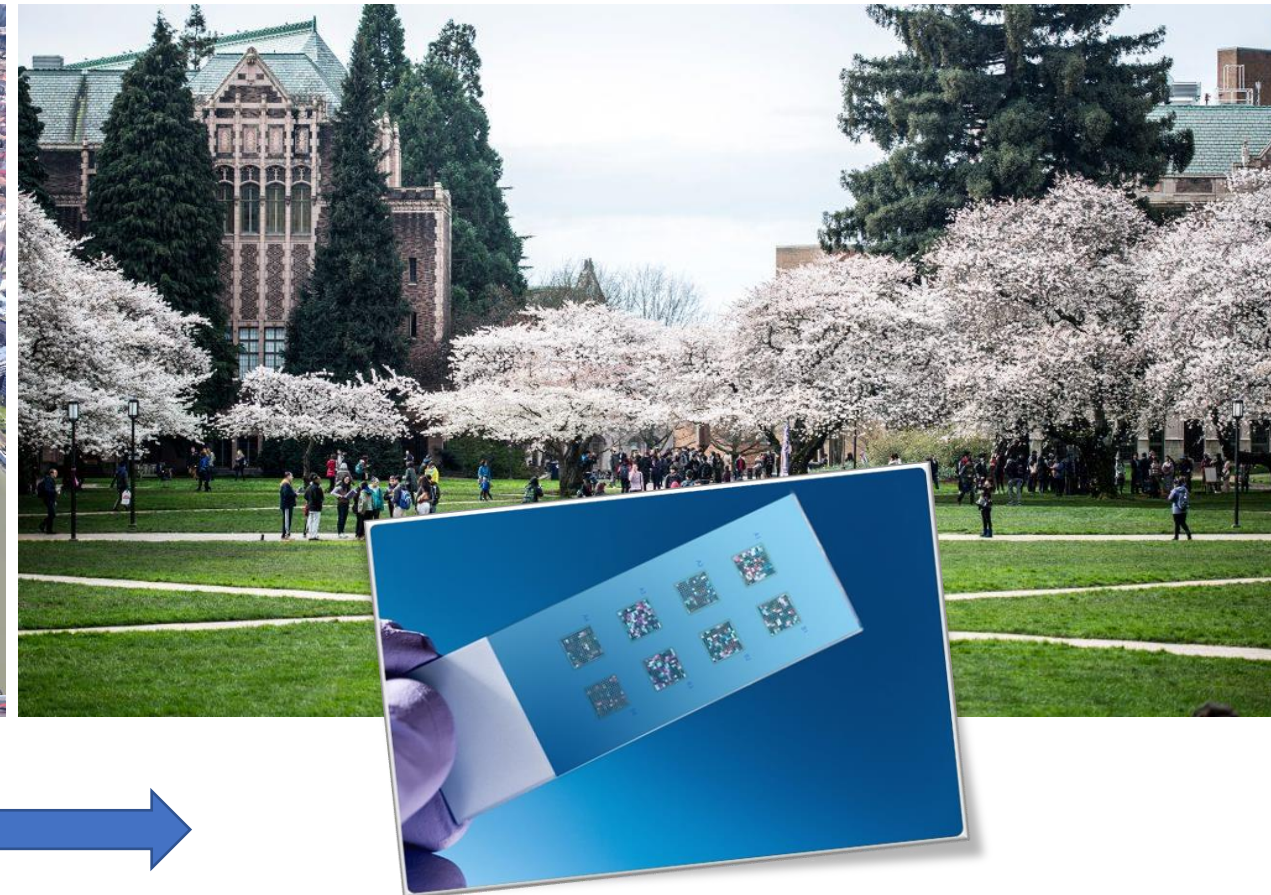
## Hungarian-American collaboration

### Department of Ethology, ELTE, Budapest



Samples from 45 brains

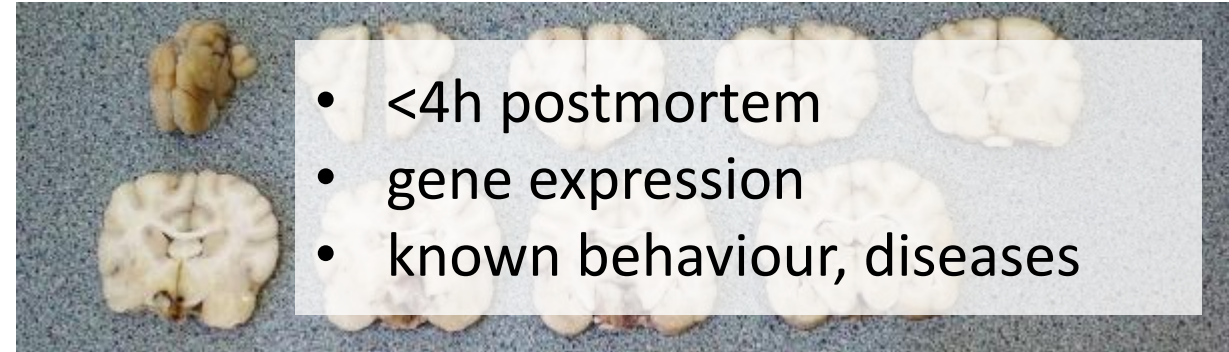
### University of Washington



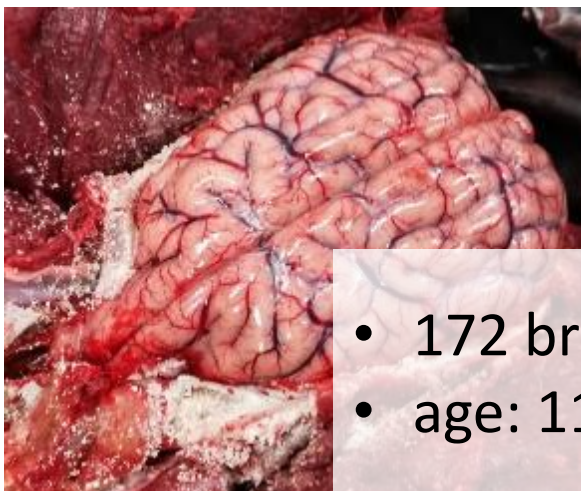
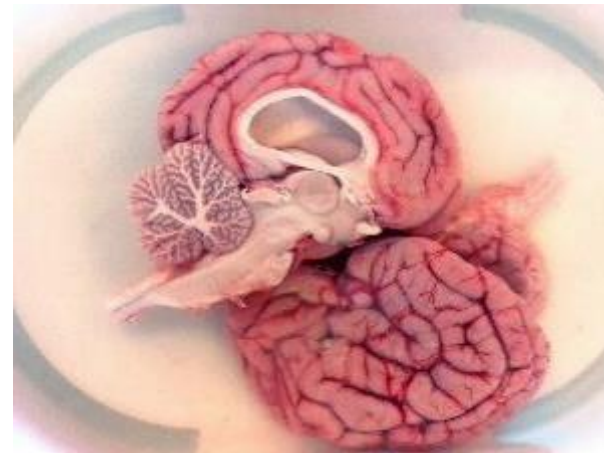
Amyloid-beta (Aβ42) peptide level



# Canine Brain and Tissue Bank, Budapest



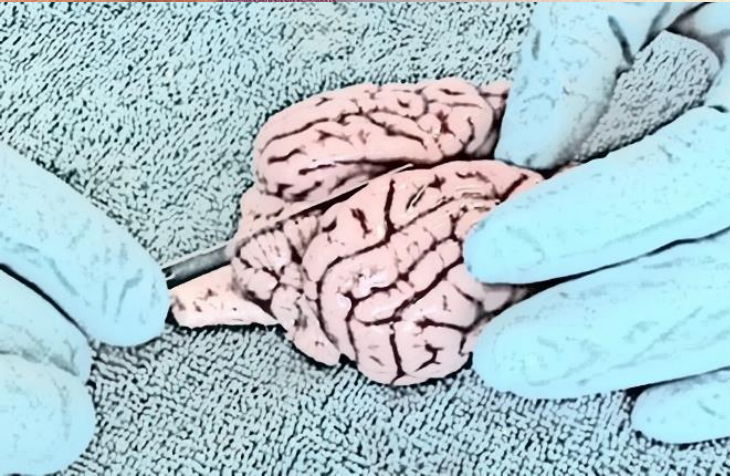
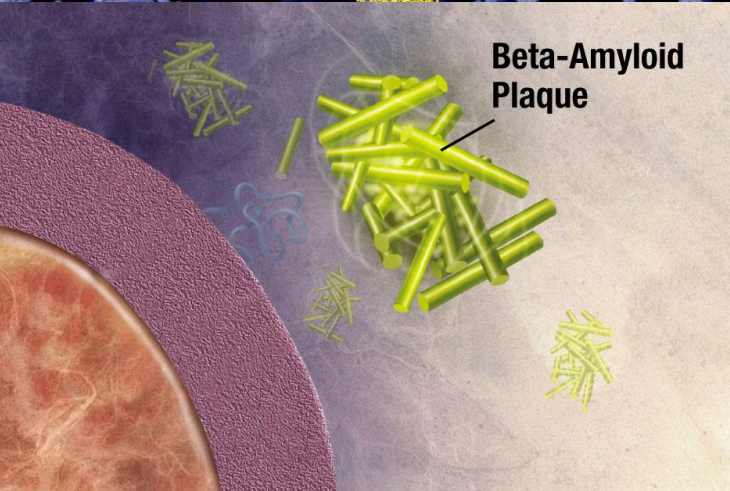
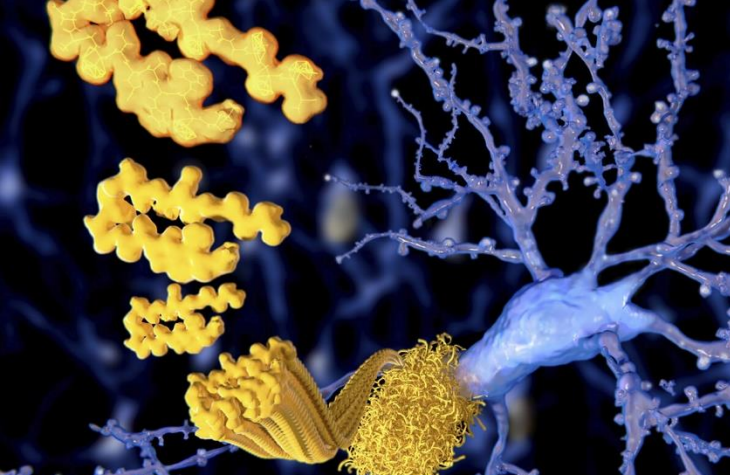
- <4h postmortem
- gene expression
- known behaviour, diseases



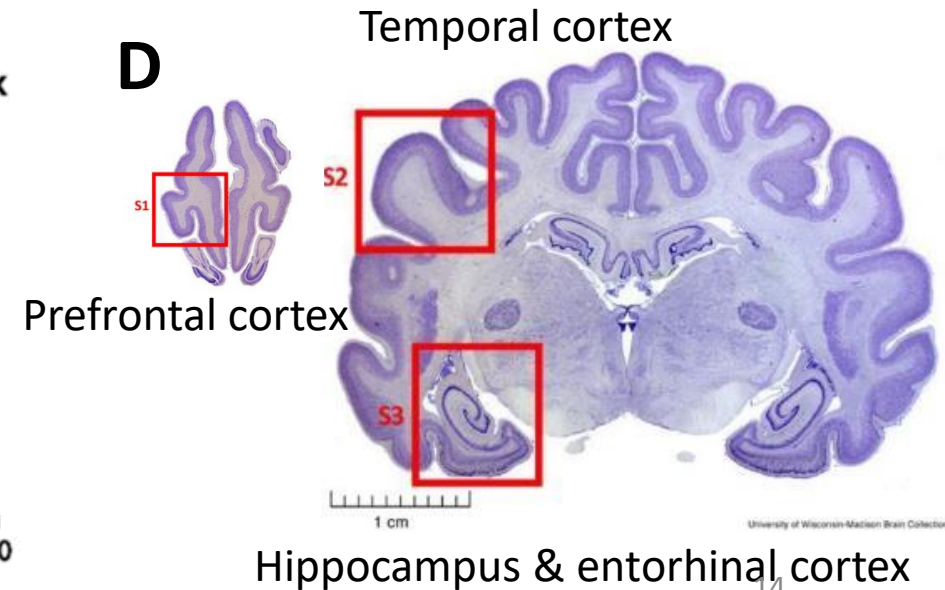
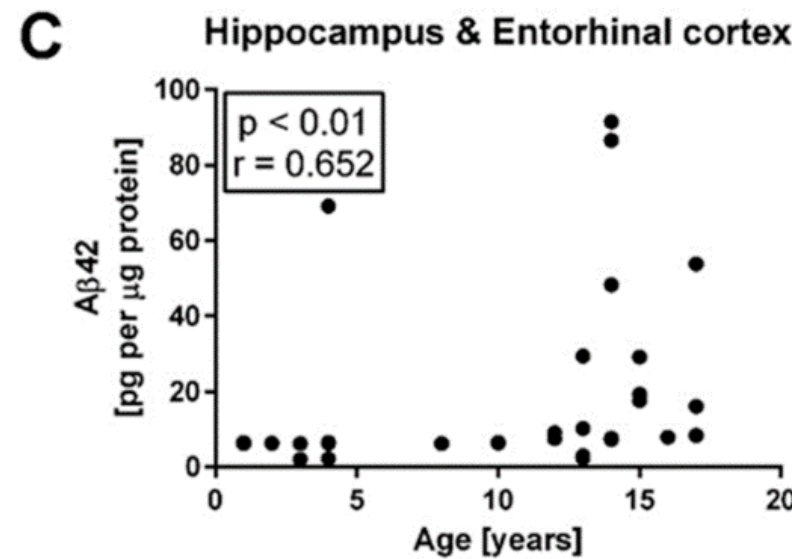
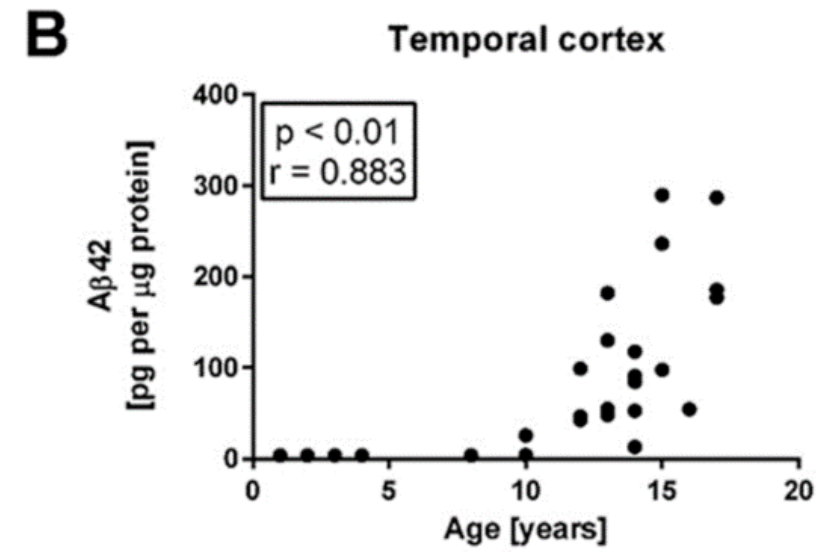
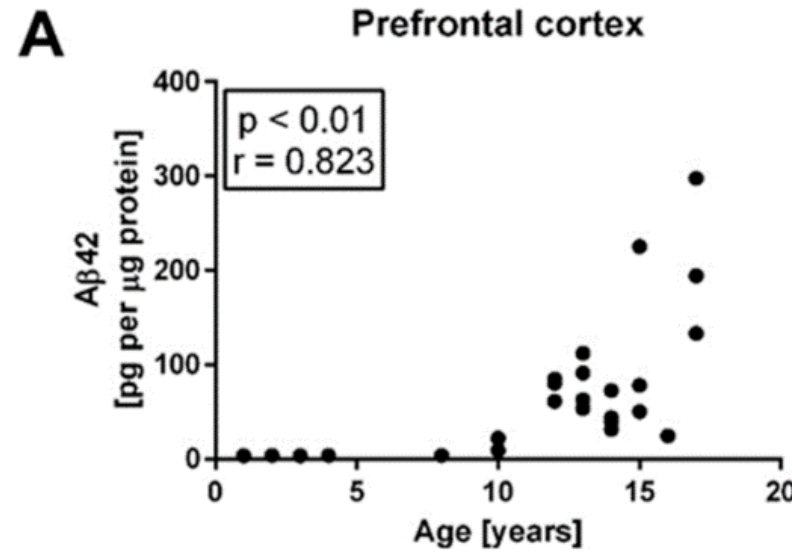
- 172 brains
- age: 11+/-5 years







# Results 1: Higher age - higher Abeta-42 level (Alzheimer's related peptide)

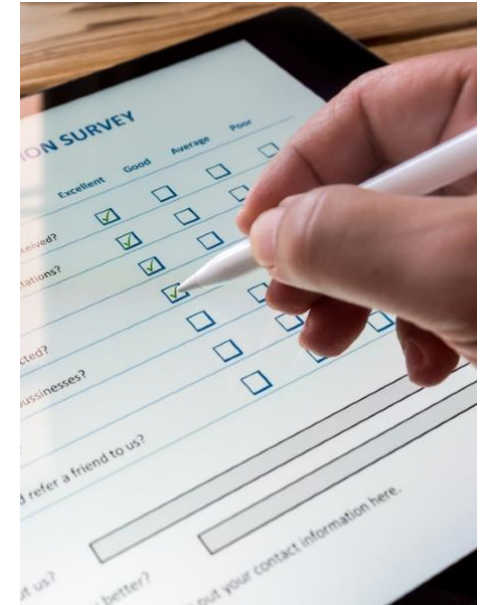




**cognitive dysfunction score** from answers to 13 questions, e.g.:

How often (from never to once a day) does your dog:

- pace up and down, walk in circles and/or wander with no direction or purpose?
- stare blankly at the walls or floor?
- get stuck behind objects and is unable to get around?
- fail to recognise familiar people or pets?



**Results 2:** Higher canine cognitive dysfunction (**CCD**) score – higher **Abeta-42** level (Alzheimer's related peptide)

- the molecular mechanism of cognitive decline in dogs can be similar to that of humans with Alzheimer's disease

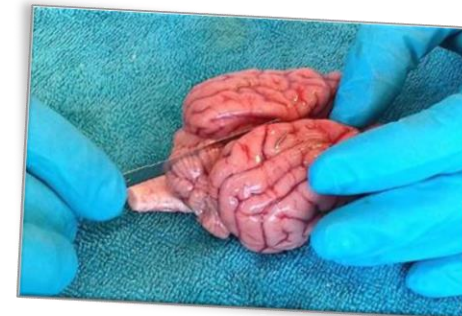
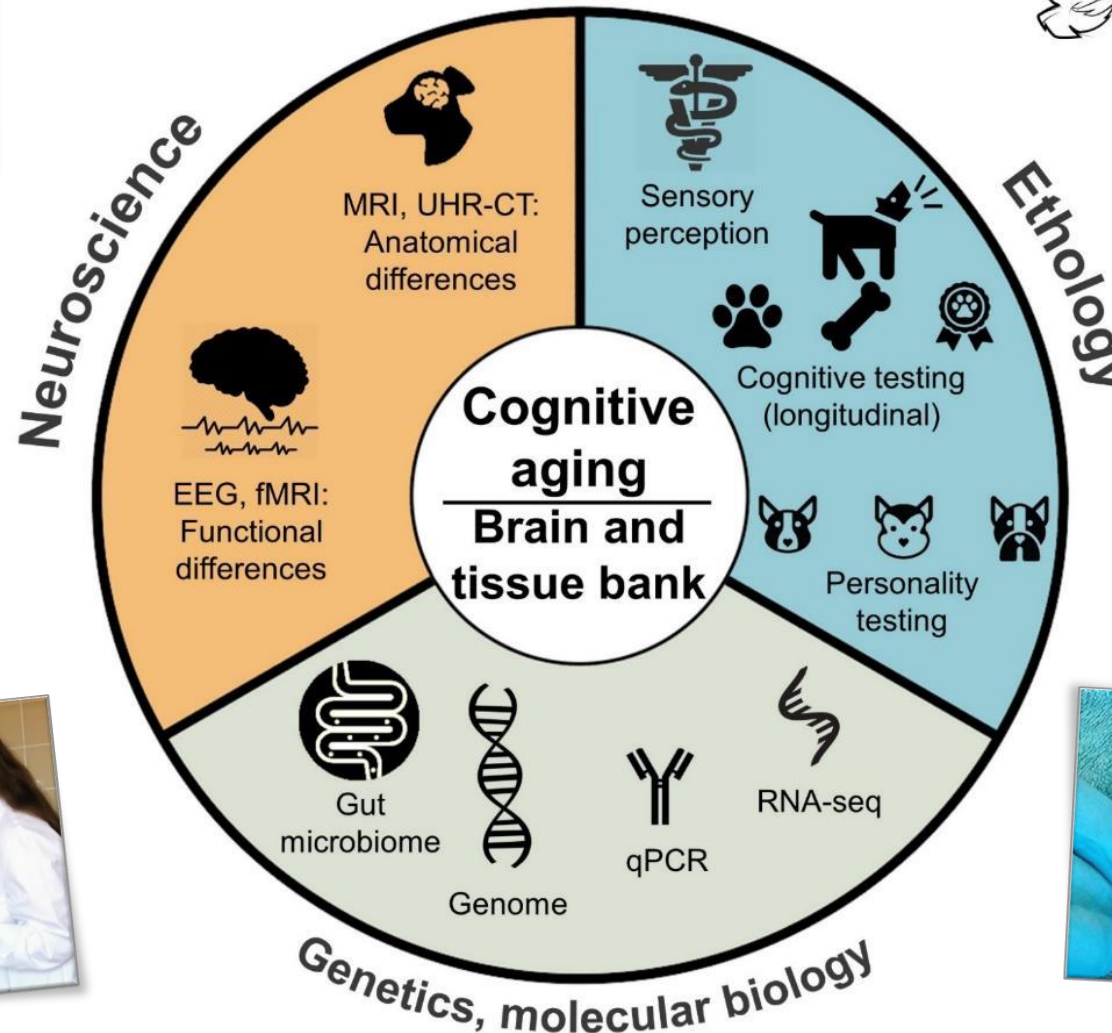
**Dog-human similarities** (cognition, personality, brain activity, gut microbiome, gene expression, mutations) → good **animal model** for ageing studies



• **60 publications**

- Test:  
N=300
- Survey:  
N=16,000

• 171  
brains





Good news:  
the majority  
of dogs (and  
humans) age  
successfully





# “Methuselah” dogs

- ~50% longer **lifespan** than the average
- ~Human centenarians (Han et al 2013, N=6)
- Identifying unique gene variants
- We compared the dogs with **850 “average”** individuals





# Whole genome sequencing

- 7.500 novel mutations
- **Function** of affected genes: Gene transcription/translation, immune system, nervous system
- We increased the sample size (Bobi 31)





Buksi (25) male mongrel <https://youtu.be/Y9xaiKV76yY>

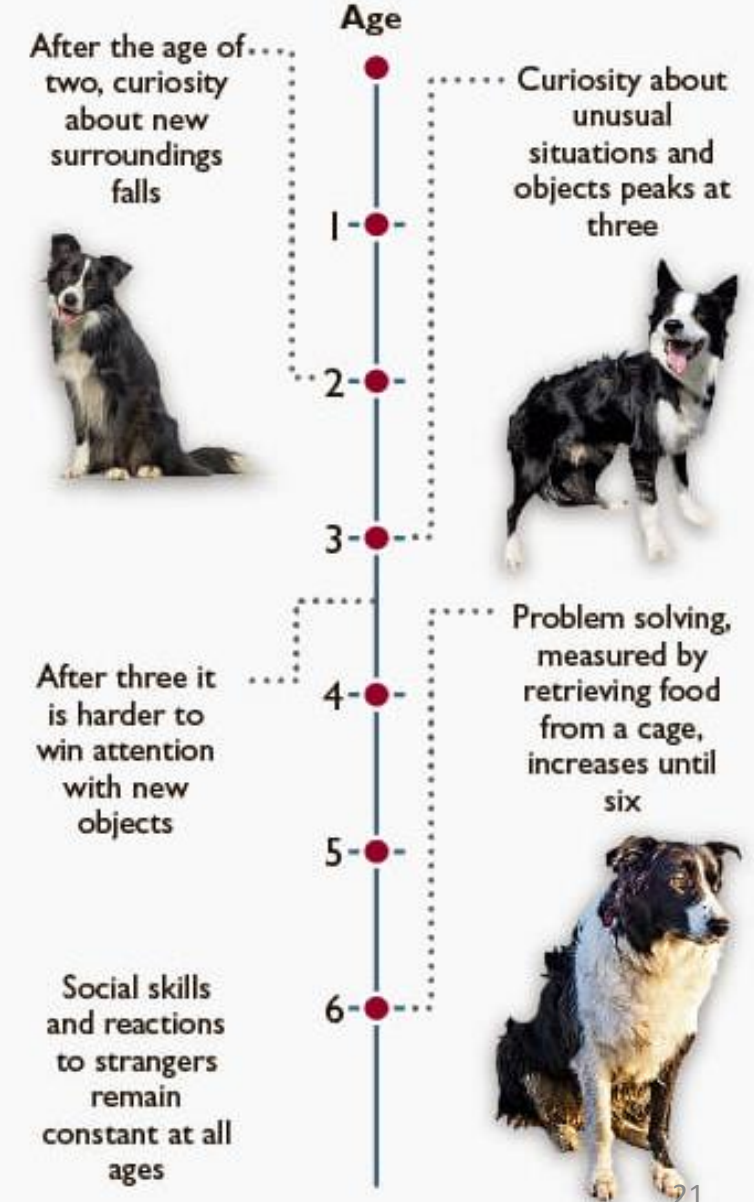


# Personality changes throughout life

➤ measured by behaviour test



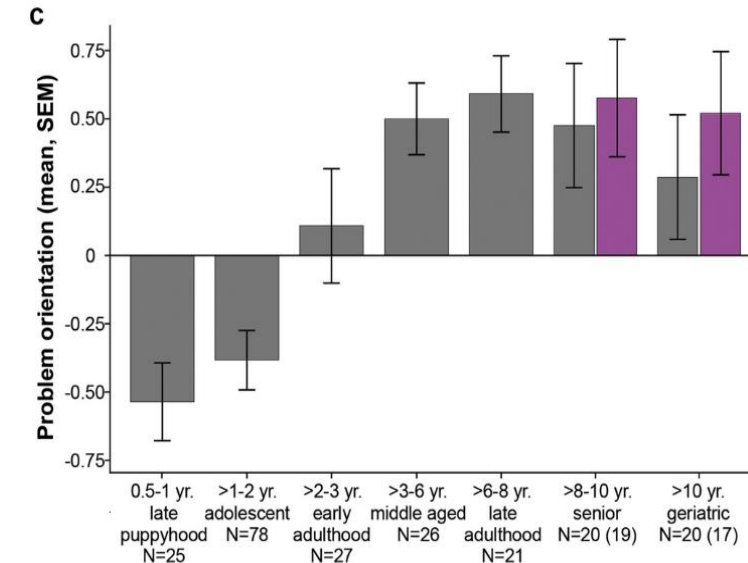
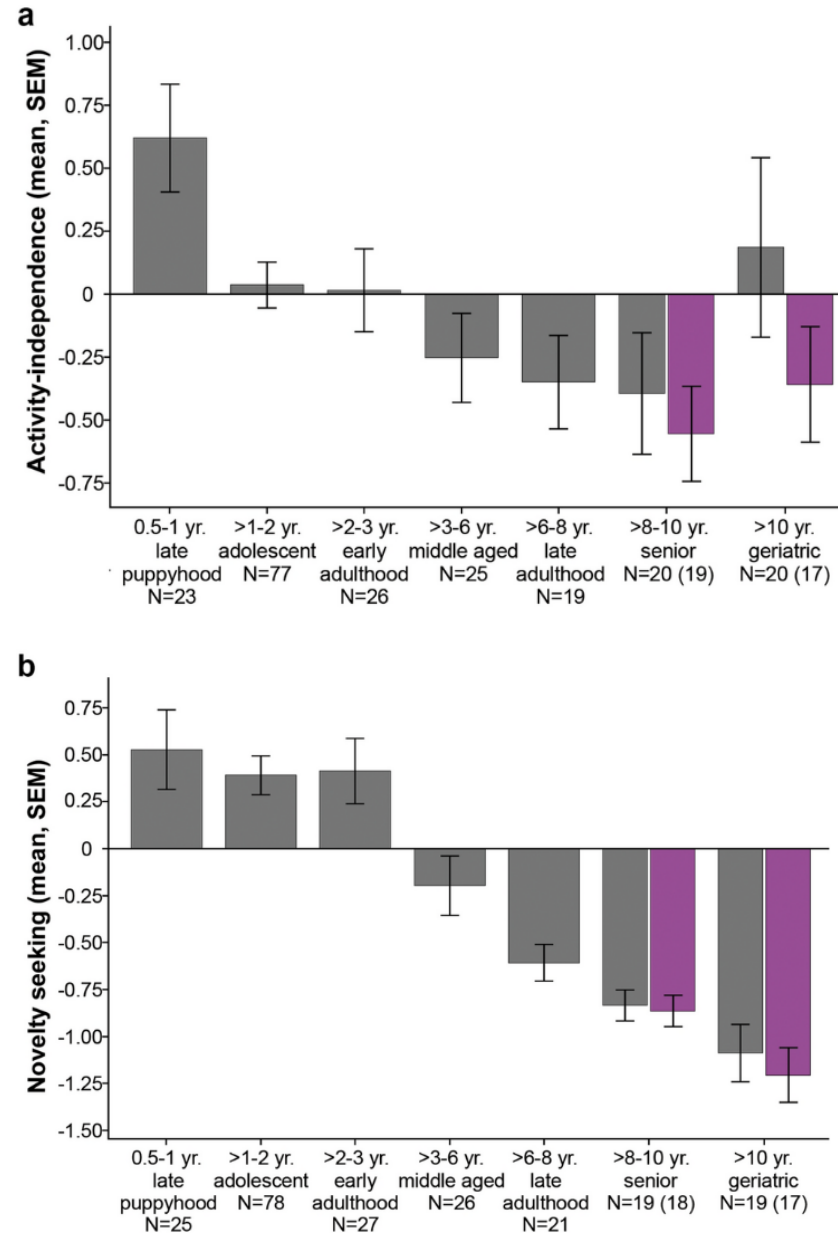
## How they change



Behaviour tests,  
N=217  
border collie

[Turcsán et al. 2020](#)

- **Activity-independence:** decreased from puppyhood to adolescence, then decreased at a slowing rate
- **Novelty seeking:** did not change until middle age, then showed a linear decrease
- **Problem orientation:** increased strongly until middle age then showed no marked changes
- **Sociability-obedience:** no change
- **Frustration-tolerance:** no change



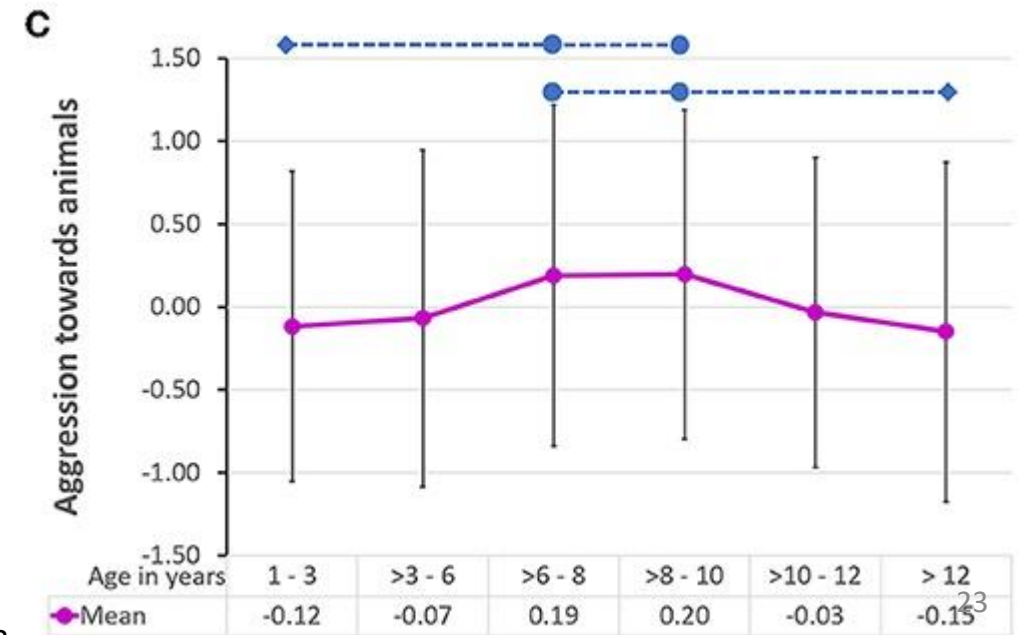
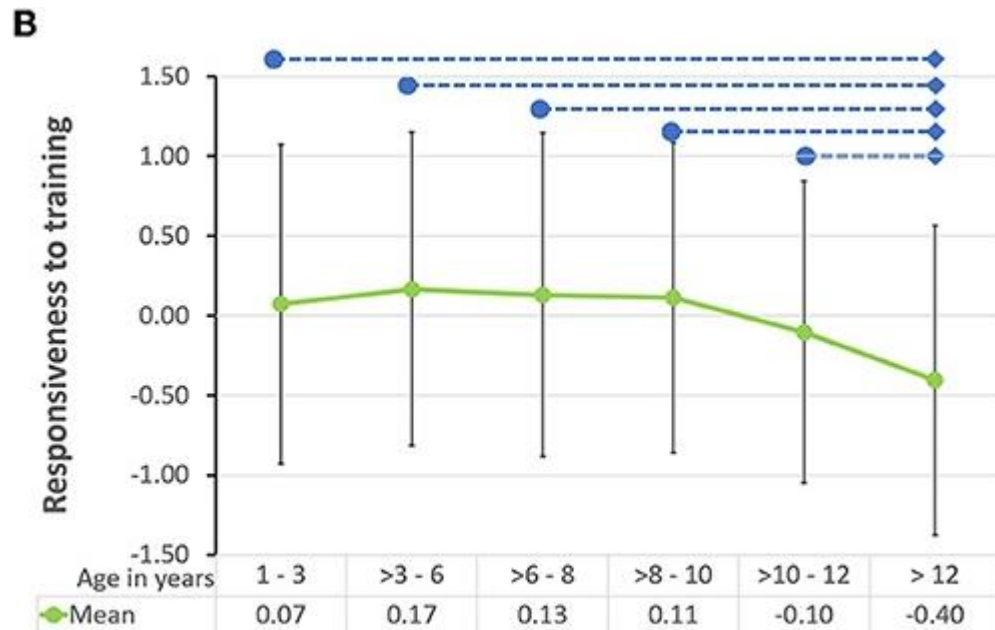
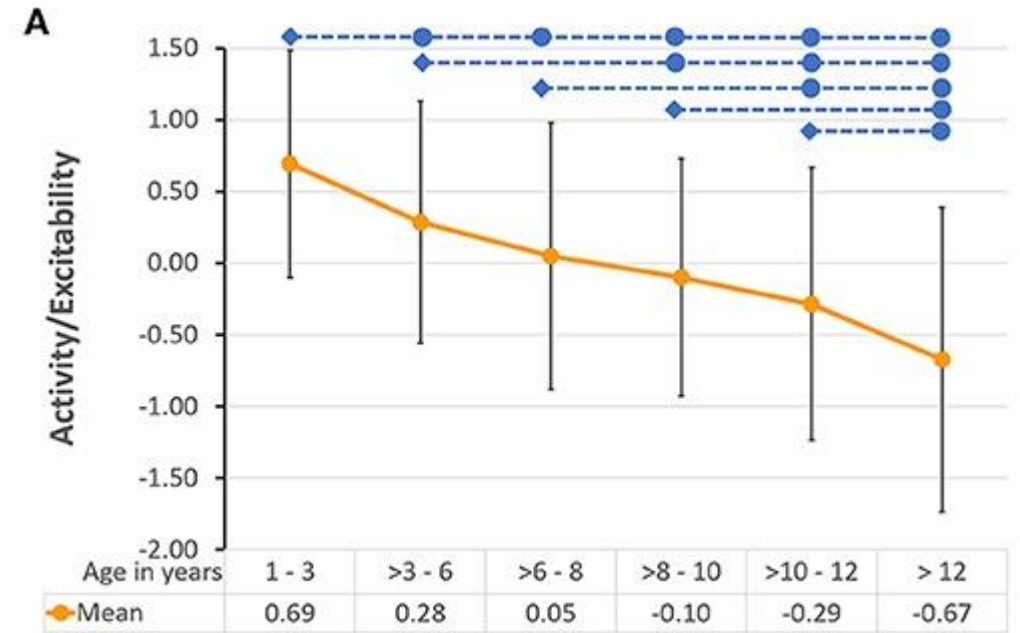
Grey bars: full sample  
Lilac bars: without 4 CCD outliers



# Personality changes throughout life

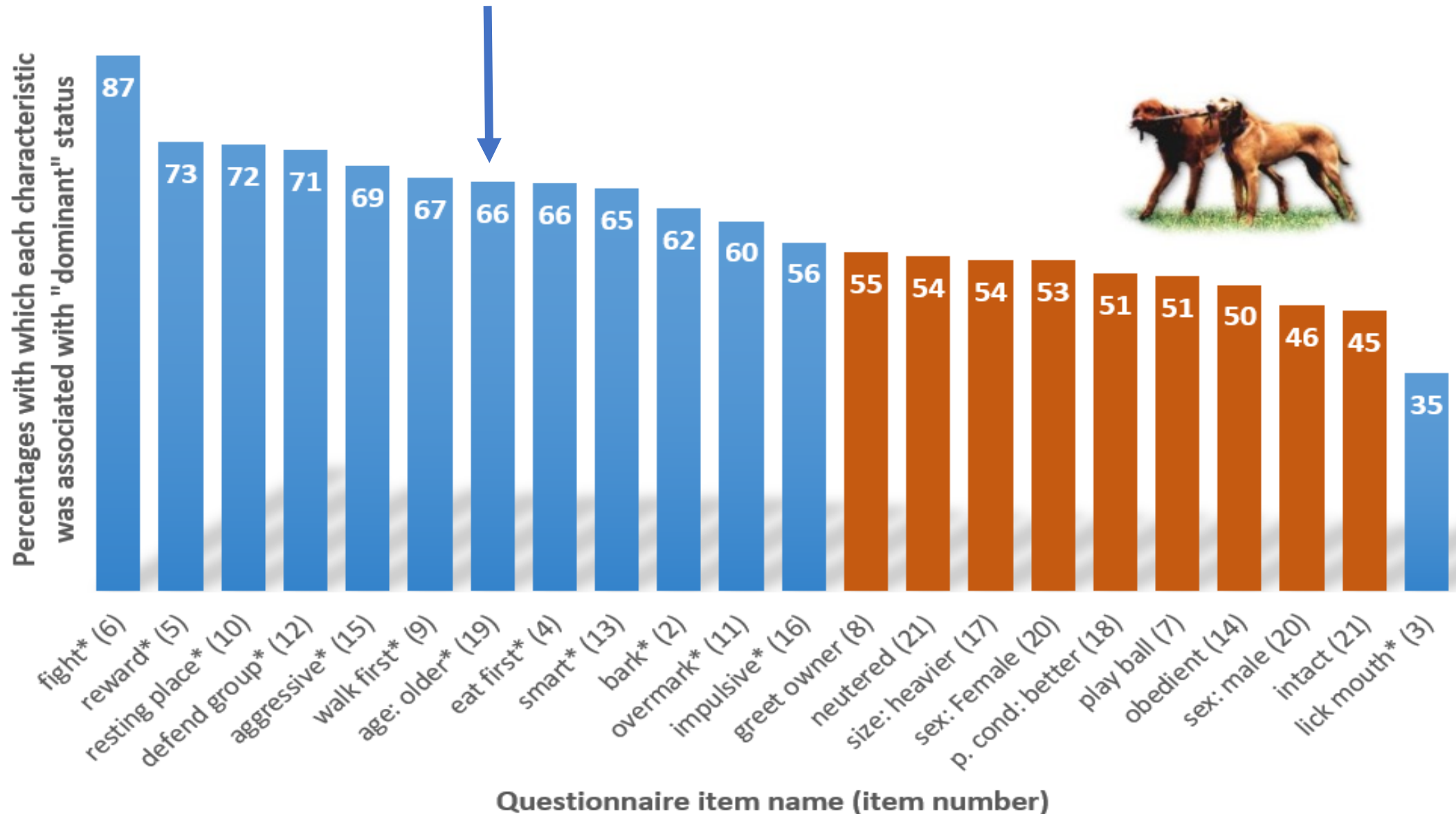
➤ measured by questionnaire

- **Activity:** decreases linearly
- **Trainability:** decreases in very old age
- **Aggression toward animals:** highest in middle-age
- **Aggression toward people:** no change
- **Fearfulness:** no change



# Age is linked to dominance in same-household dogs

- In dog pairs, the dominant dog is **older** in 66% of the cases

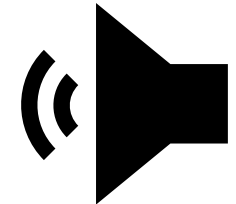




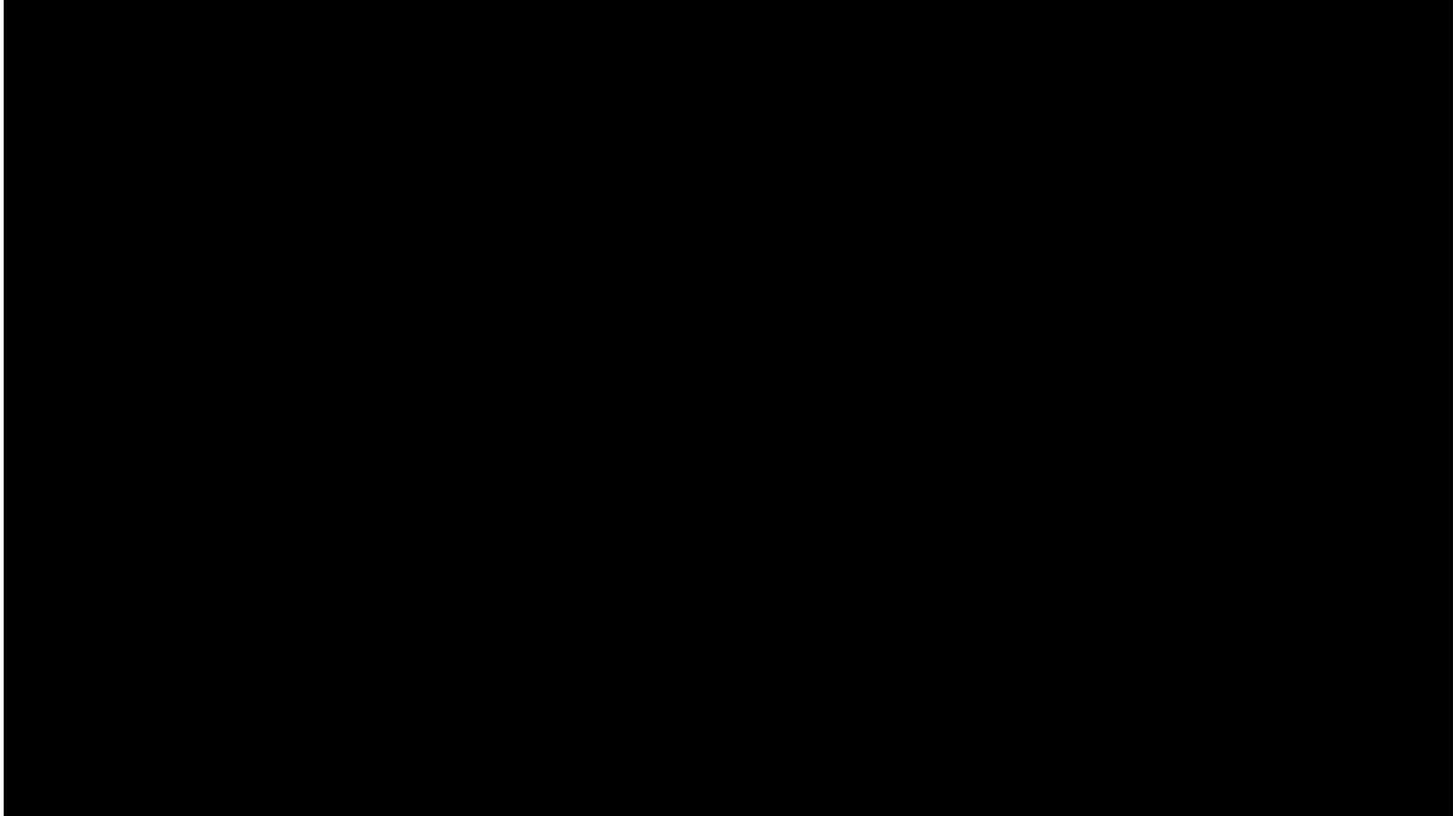
# Emotion processing: “Selective” hearing in old dogs

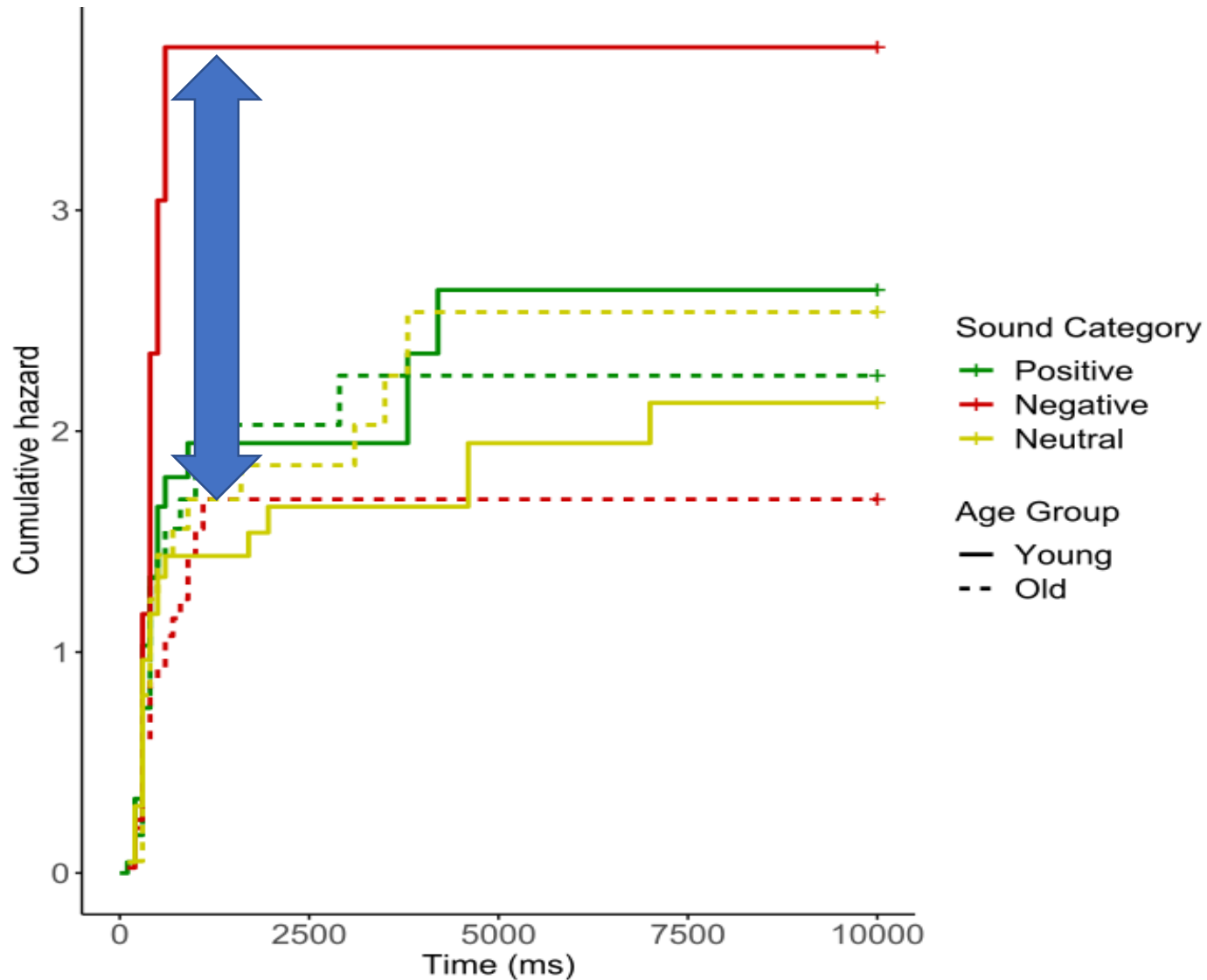
- older people experience fewer negative emotions, they are happier - 'positivity effect'
- do they think a lot about death?
- or their brain processes negative emotions worse?
- we don't know – tests on animals are needed











- old dogs reacted less to **negative emotions** (but not to positive or neutral)
- effect of brain aging (brain stem and amygdala degeneration)

*“old dogs only hear what they want to hear”*

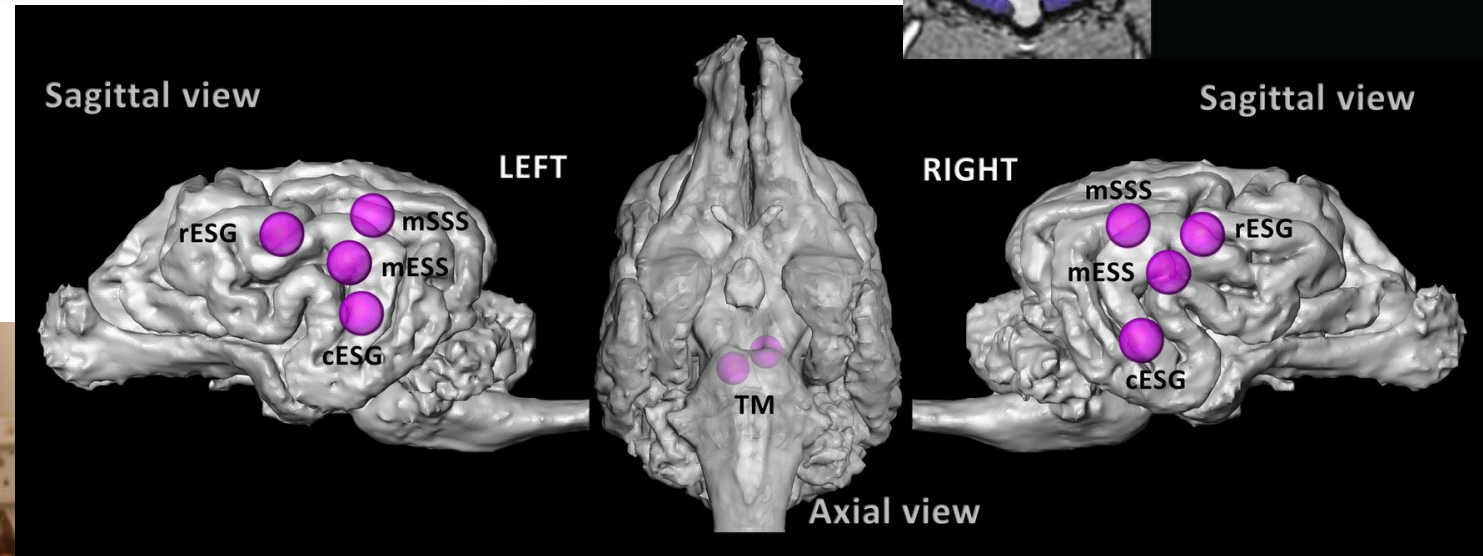
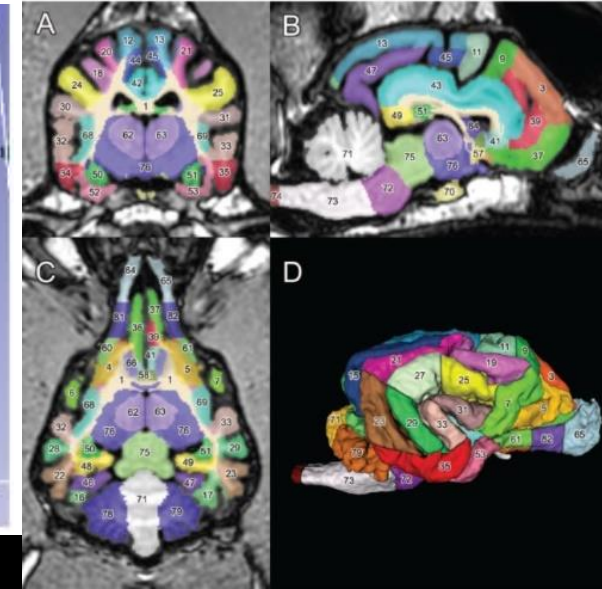
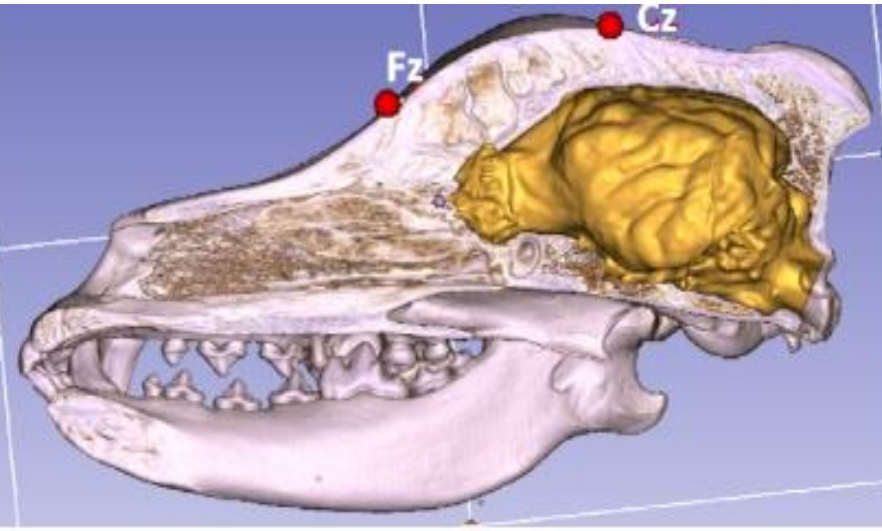
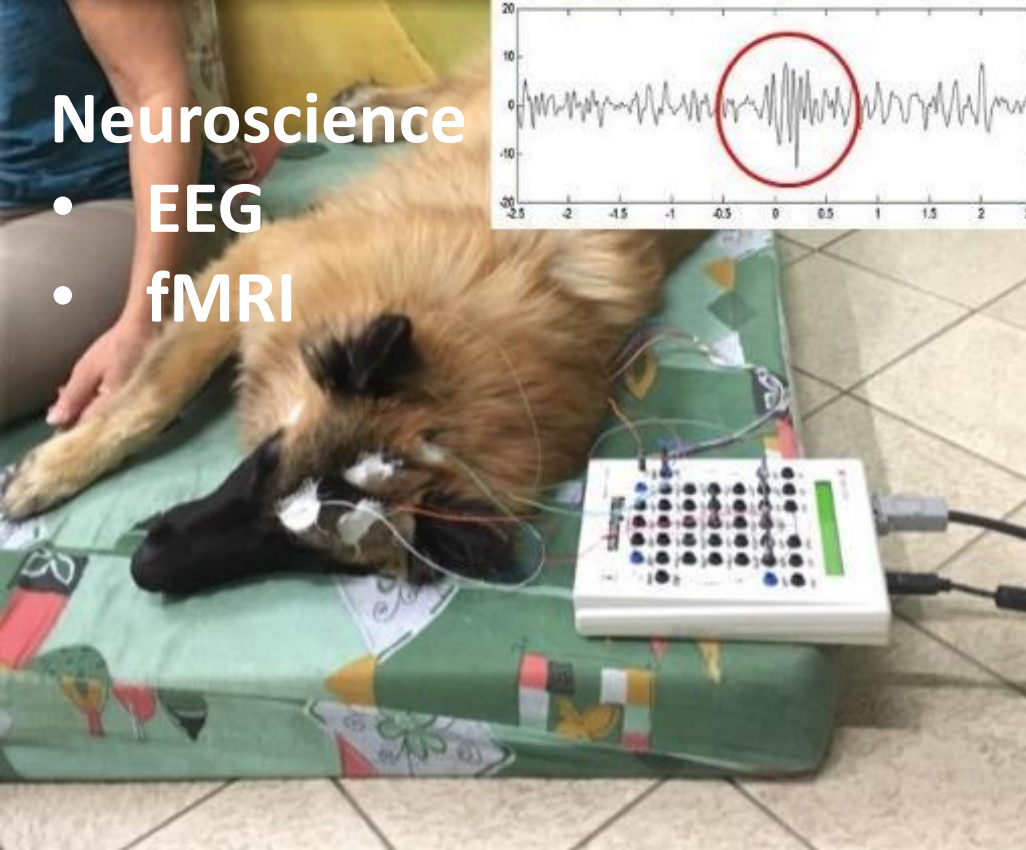


log-rank test, young: 95% CI: 300; 300, old: 95% CI: 300; 800,  $p=0,021$



# Neuroscience

- EEG
- fMRI





# Overview about the ageing studies

- similarities with human ageing
  - behavioural (memory decline, personality changes, dominance, positivity effect)
  - neuroscientific (brain activity with EEG, fMRI), and
  - molecular level (Abeta, "longevity" genes)
- contribution to welfare
- dogs are good animal models for ageing studies - especially in dementia research





# Advices for a long and healthy canine life

1. Genetics: Conscious breed-choice, consider size (ideal: 10-30 kg, Turcsán et al., 2023)
2. Healthy weight, calorie restriction
3. Spaying (females)
4. Mental stimulation, training
5. Physical training
6. Autonomy, social life
7. Regular consultations with the vet





## How can dog research help humans?

- longitudinal studies
- similar diseases - model
- genetic markers
- awareness raising

## How can owners help ageing dogs?

- conscious choice
- ideal weight
- spaying (females)
- mental, physical, social stimulation



ELTE Department of Ethology 2020, MTA-ELTE Companion Animal Research Group, MTA NAP 3.0. Canine Brain Research Group, <https://ethology.elte.hu/>