Age-related differences in reading subtitles: an eyetracking study

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Presentation outline

- Ageing
- Ageing and reading
- Subtitle reading process
- Reading and hearing status
- Does age affect the subtitle reading process?

Ageing

- "Ageing is one of the greatest social and economic challenges of the 21st century for European societies. It will affect all EU countries and most policy areas."
- "By **2025** more than **20% of Europeans will be 65 or over**, with a particularly rapid increase in numbers of over-80s."

http://ec.europa.eu/health/ageing/policy/index_en.htm

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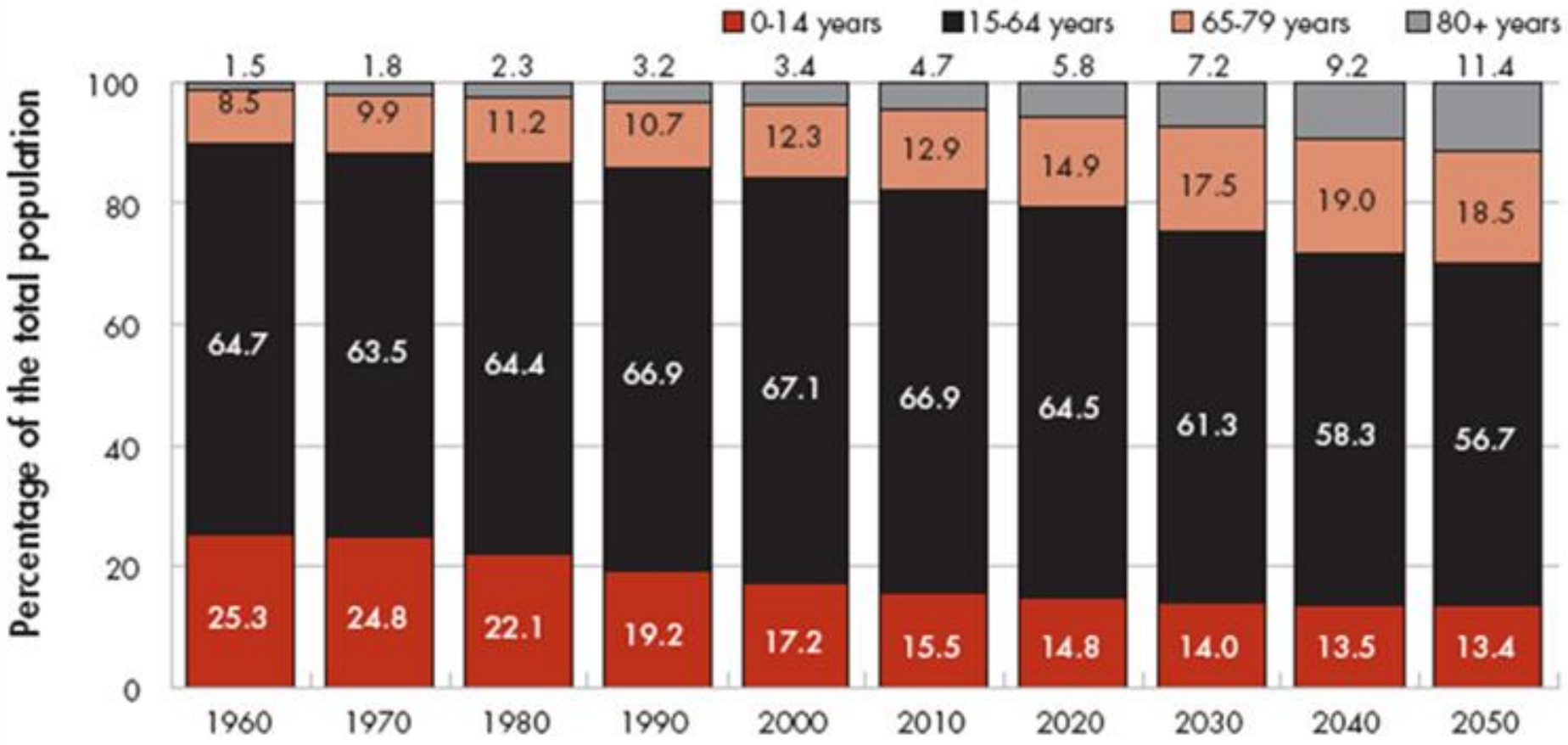
Population structure by major age groups, EU-25; 1960, 1970, ..., 2050



Sources: Eurostat – Demographic statistics (1960-2000) and 2004-based Eurostat population projections, trend scenario, baseline variant (2010-2050).

Ageing

- Ageing affects all aspects of information processing
- Poor performance on cognitive tasks due to sensory and cognitive decline
  - Perceptual speed (Salthouse 1992, 1996)
  - Working memory (Kemtes & Kemper 1997)
  - Lexical processing (Rayner et al. 2006)
  - Visual deficits (Akutsu, Legge, Ross, & Schuebel 1991)

Ageing and reading

- Older adults make more fixations and regressions than younger readers
  (Rayner et al. 2006; Kemper, Crow, & Kemtes, 2004; Kliegl, Grabner, Rolfs, & Engbert 2004; Solan, Feldman, & Tujak 1995)
- Older readers' fixation durations are longer
  (Kliegl et al. 2004; Rayner et al. 2006; Stine-Morrow et al. 2010)
- Older readers make longer saccades and skip words more frequently
  (Laubrock, Kliegl, & Engbert 2006; Rayner et al. 2006)
- Older readers have a slightly smaller and less asymmetric perceptual span
  (Rayner, Castelhano, & Yang 2009)

→ **Older people read more slowly**
(Stine-Morrow, Miller, & Hertzog 2006)

Subtitle reading

- Reading printed text vs. reading subtitles
  - "Static text on stable background vs. fleeting text on dynamic background" (Kruger & Steyn 2013)
- Viewers have no control over subtitle presentation rate (reading speed)
- Reading competes with others sources of information:
  - listening to the audio track
  - watching the images
- Reading subtitles: higher cognitive load than reading printed text

Reading and hearing status

- "Hearing status and literacy tend to covary" (Burnham et al. 2008)
- Deaf people tend to be poorer readers compared to hearing people
- When reading subtitles, deaf and hard of hearing people tend to:
  - Spend more time reading subtitles (higher dwell time, more fixations, longer FFD)
  - Achieve lower comprehension scores (Szarkowska et al. 2011)

Previous eyetracking studies on age and subtitling

- Dubbing vs. subtitling in younger and older adults (Perego et al. 2014)
  - Older adults performed worse on all cognitive measures (comprehension, scene recognition, face-name association, dialogue recognition)
  - Young adults better remembered the colour and layout of subtitles in the study
- Eye movements of children and adults while reading TV subtitles (d'Ydewalle & de Bruycker 2007)
  - Children had longer fixations and shorter saccades when reading subtitles compared to adults
  - Children took longer to shift attention to the subtitle at its onset

DOES AGE AFFECT THE SUBTITLE READING PROCESS?

THE STUDY


jest zupełnie inaczej postrzegany
przez dwie grupy dziennikarzy:

Study material

- Main study:
  - 13 clips of 1-2 minutes each
- This study: subtitles from three documentaries
  - *Super Size Me*
    2004, dir. Morgan Spurlock
  - *Roman Polański: Wanted and Desired*
    2008, dir. Marina Zenovich
  - *Polskie Państwo Podziemne*
    2002, dir. Andrzej Sapija
- Subtitles
  - Max. two lines of 38 characters each
  - EZTitles subtitling software

Participants

- Total number: 134
- Hearing loss
  - **43** Deaf
  - **31** Hard of hearing
  - **60** Hearing

AGE	Deaf	HoH	Hearing
Mean (SD)	25.63 (14.17)	28.58 (13.83)	29.35 (11.24)
min	14	17	21
max	67	70	63

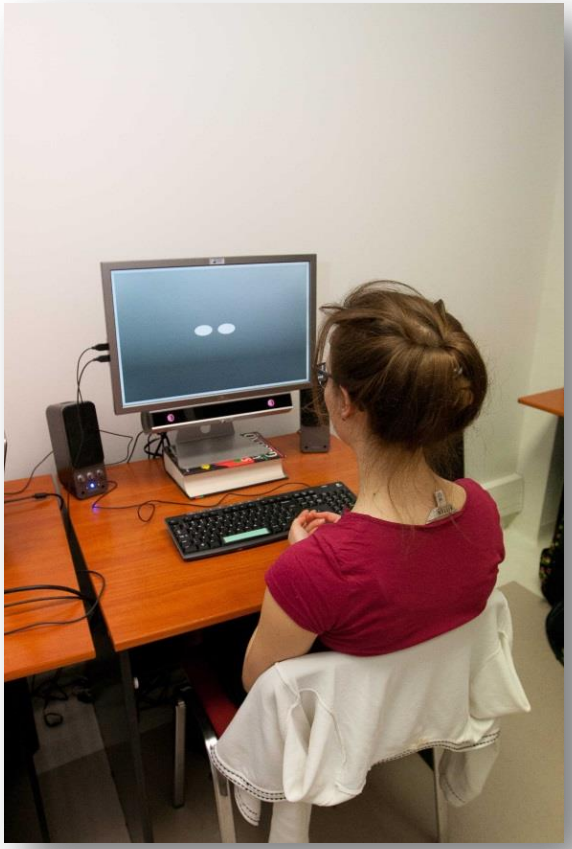
No age differences between groups, F (2,131) = 1,09 ns

Procedure

- Informed consent form
- Demographic data collection
- Calibration
- Film watching
- Comprehension questions

Eye movement recording

- SMI RED eyetracking system with a sampling rate of 120 Hz
- 21-inch monitor at a distance of about 60 cm
- Data analysis: BeGaze & SPSS



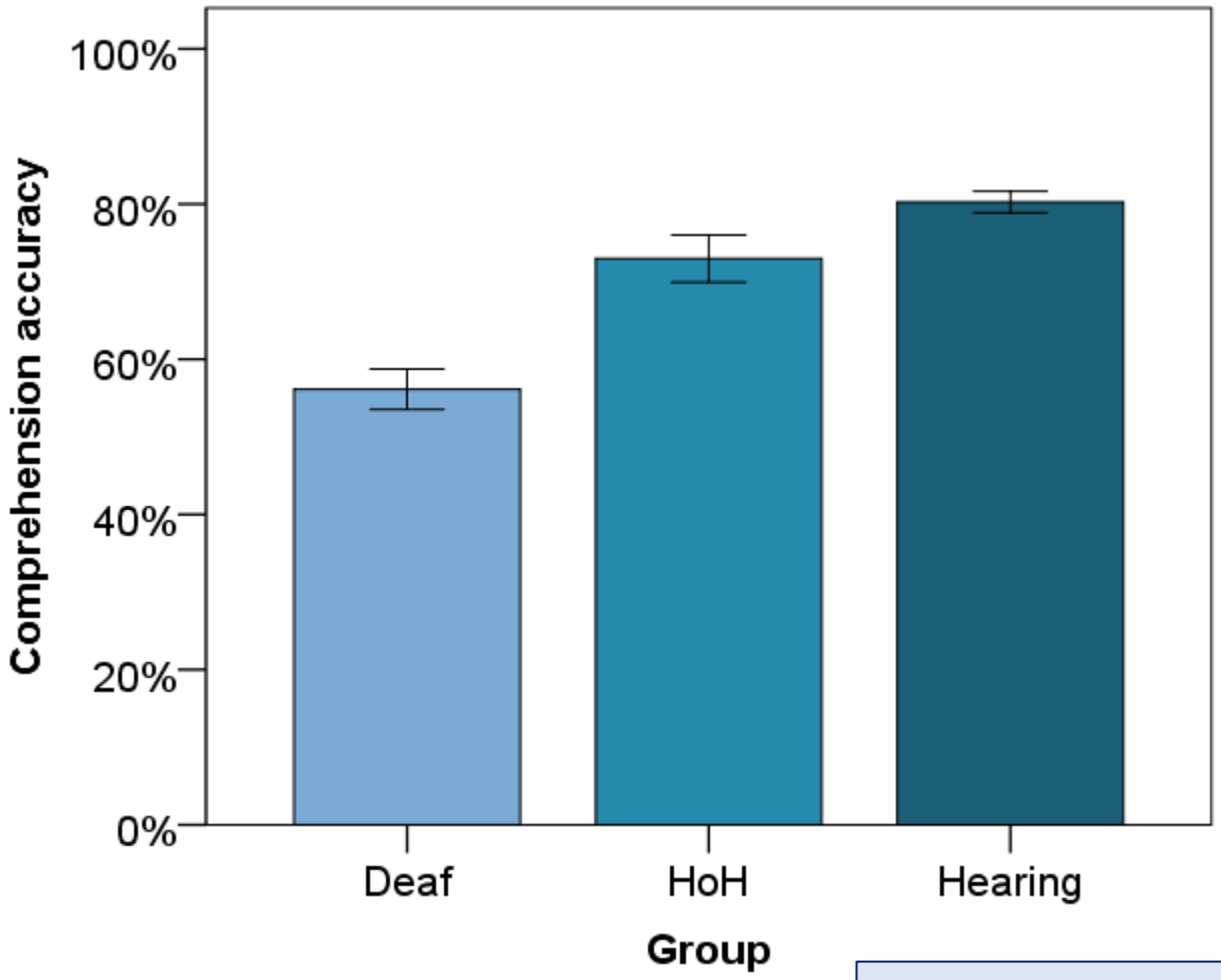
Eyetracking measures

- **Dwell time (DT)** = sum of durations from all fixations and saccades that hit the AOI
- **Glance count (GC)** = Number of glances to the AOI (saccades coming from outside)
- **Fixation count (FC)** = number of fixations in the AOI
- **First fixation duration (FFD)** = Duration of the first fixation to hit the AOI

AOI on subtitles

RESULTS

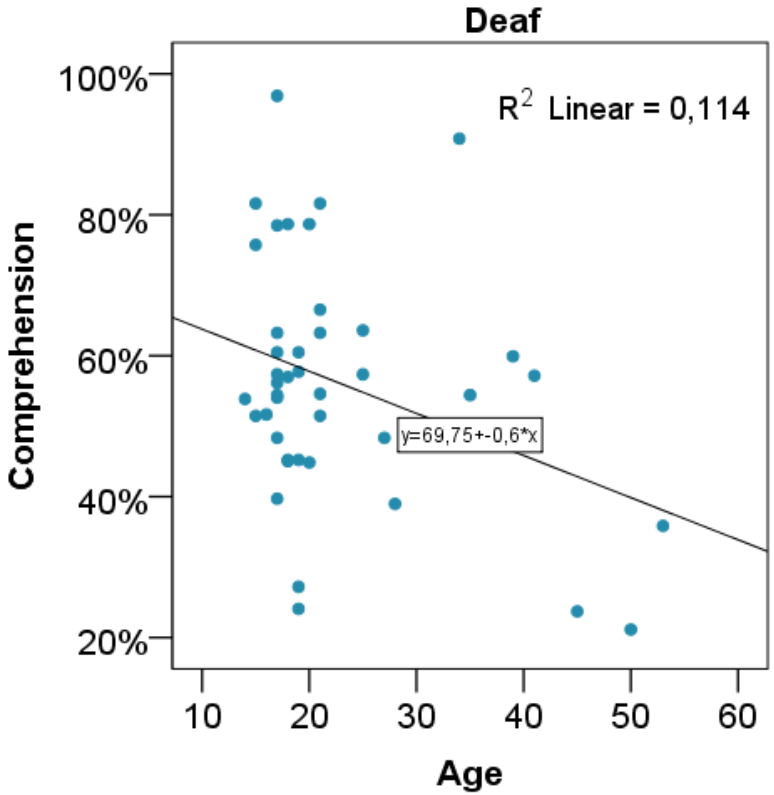
Comprehension by hearing status



Deaf M: 55.4816% SD 17.89526%
HoH M: 73.0357% SD 16.17836%
Hearing: M: 80.0757% SD 10.43004%
F(2, 141) = 38.45, P <0.001; eta2 = .353

Age & comprehension: deaf viewers

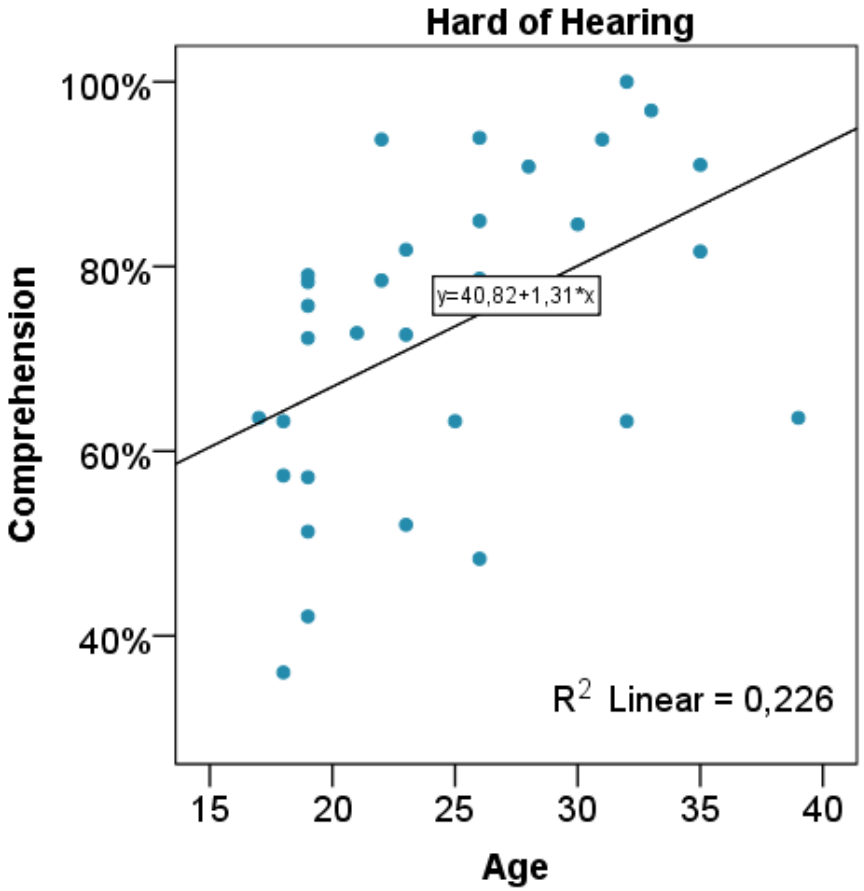
NEGATIVE TENDENCY BETWEEN AGE AND COMPREHENSION → COMPREHENSION DECREASES WITH AGE



(r = -0.3, p = 0.06)

Age & comprehension: hard of hearing viewers

POSITIVE CORRELATION BETWEEN AGE AND COMPREHENSION → COMPREHENSION INCREASES WITH AGE

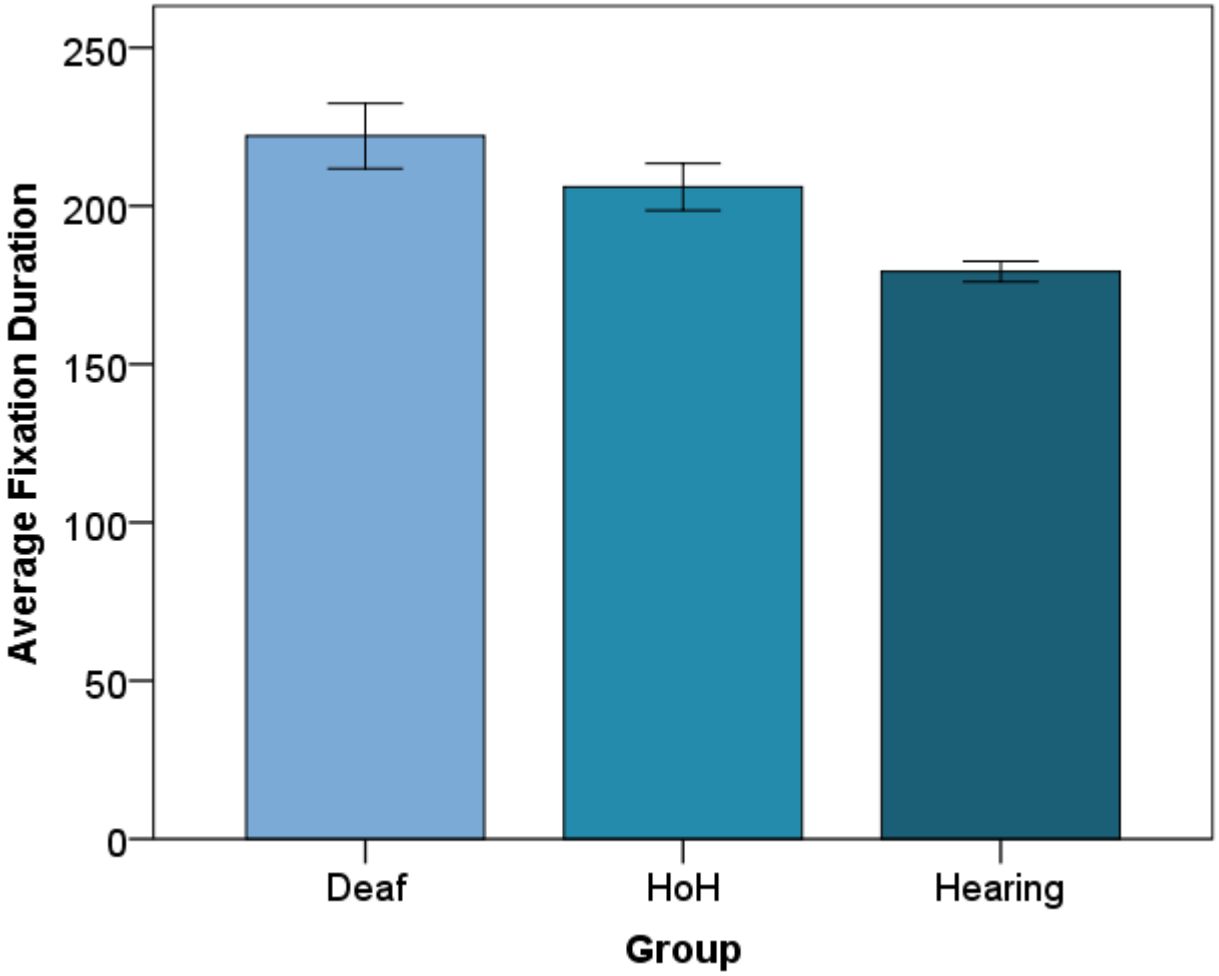


(r = .48, p = 0.01)

Age & comprehension: hearing viewers

- No correlation between age and comprehension was found

Fixation duration on AOI



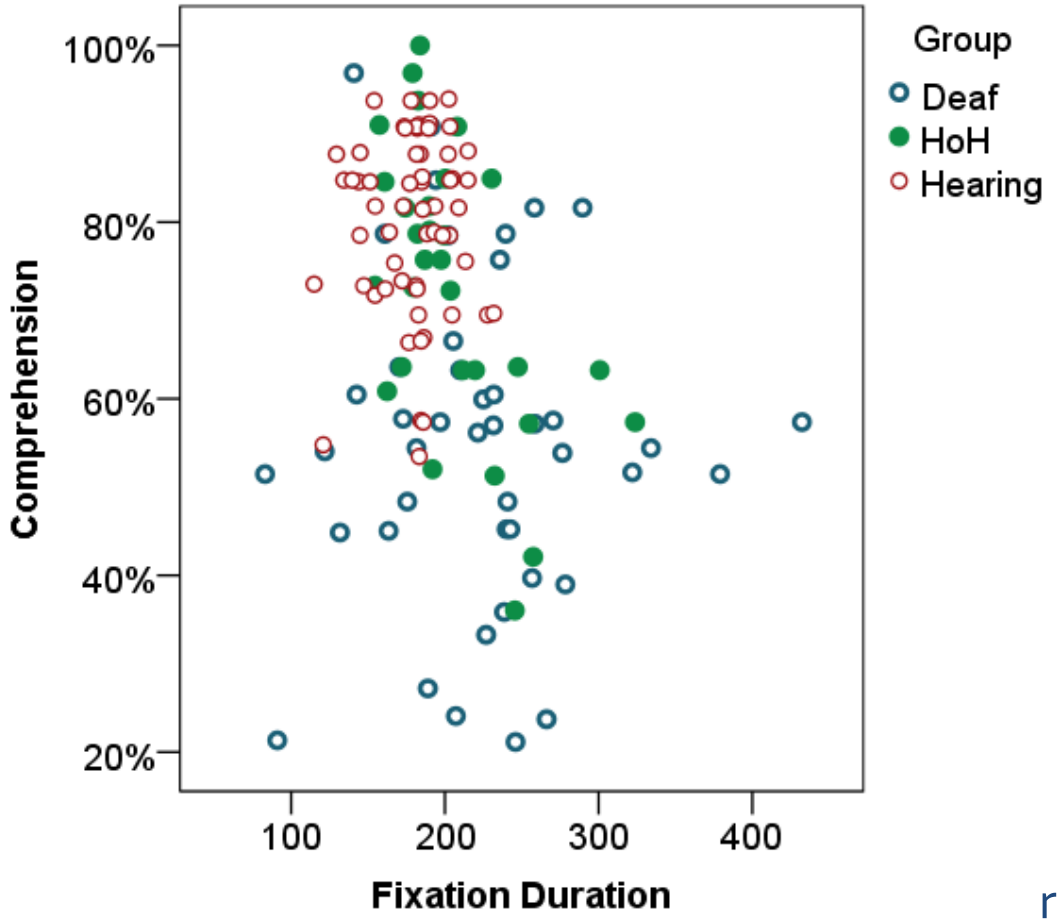
HEARING VS. DEAF & HARD OF HEARING
F(2, 131) = 11.05, P<0.001, ETA2 = .144

Comprehension and fixation duration

NEGATIVE CORRELATION BETWEEN COMPREHENSION AND FD

→

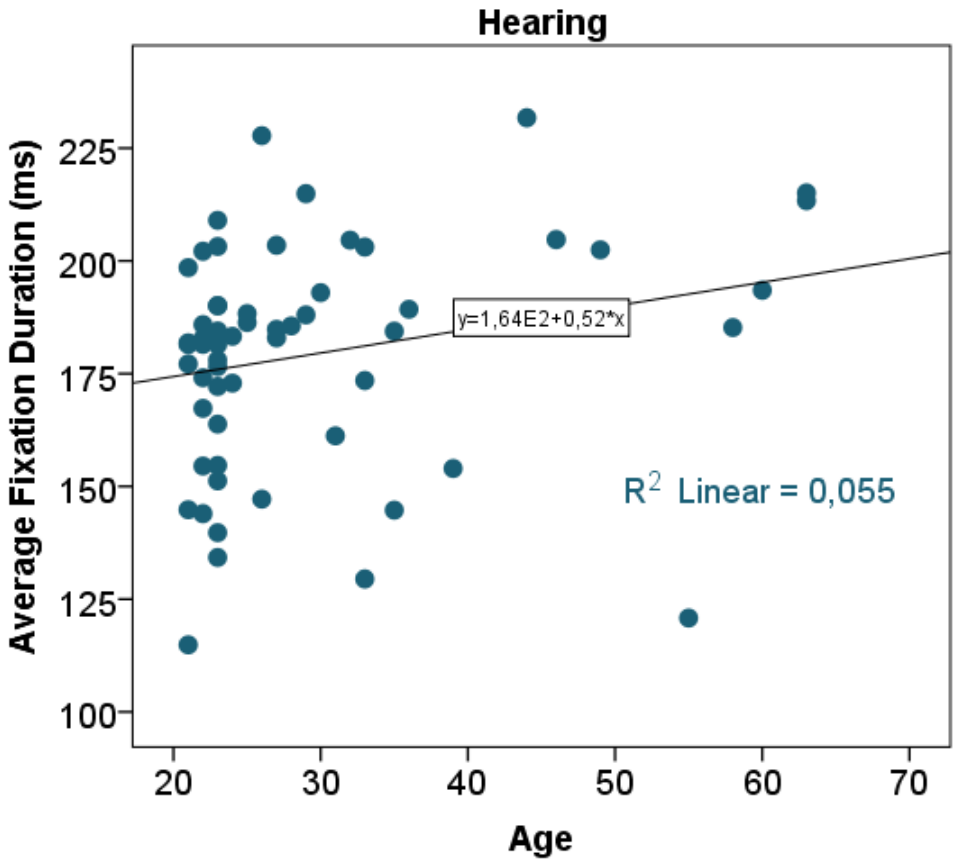
THE BETTER THE COMPREHENSION, THE SHORTER THE FIXATION DURATION



r = 0.39, p< 0.001

Age and fixation duration: Hearing

POSITIVE TENDENCY BETWEEN AGE AND FD → FIXATION DURATION INCREASES WITH AGE

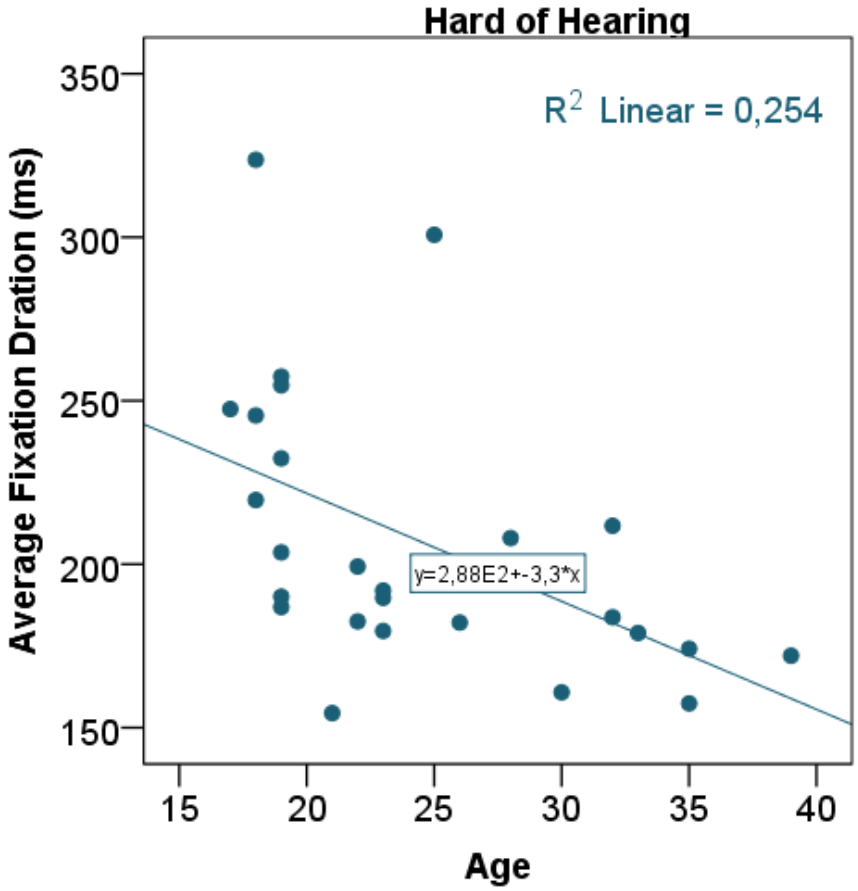


r = 0.23, p = 0.07

Age and fixation duration: Hard of hearing

NEGATIVE CORRELATION BETWEEN AGE AND FD

FIXATION DURATION DECREASES WITH AGE



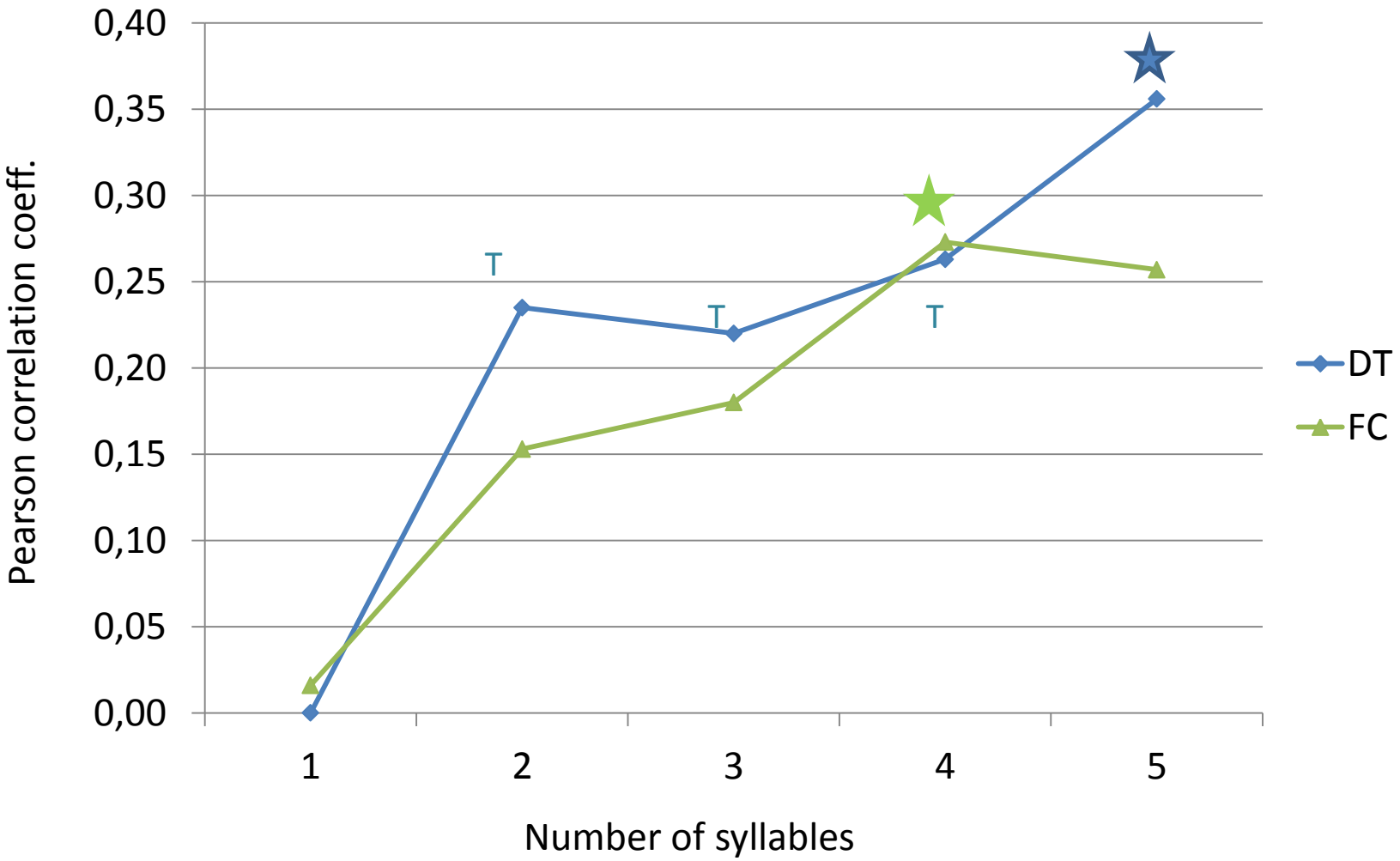
Correlations between age and eye metrics

	Deaf	HoH	Hearing
Dwell time	-.01	**-.40***	**.31***
Fixation count	.05	-.22	**.27***
Glances count	-.05	**.36***	.11

* significant correlation

- **Deaf viewers** – no correlations
- **Hard of hearing viewers**
  - DT is getting shorter with age
  - The number of GC on subtitles increases with age
- **Hearing viewers**
  - Older people have longer DT and higher FC

Age & word length: Hearing viewers



Summary

- Differences in subtitle reading patterns between deaf, hard of hearing and hearing viewers
- Age and time spent in subtitle
  - Deaf viewers – no correlations
  - Hard of hearing viewers
    - Negative correlation: older people spent less time on subtitles
    - FD and DT didn't increase with age
    - Born HoH vs. age-related hearing loss
  - Hearing viewers
    - Positive correlation: older people spent more time on subtitles

Conclusions and future research

- Confirmation of previous studies on normal reading on older adults, but only on hearing people
  - Time spent on reading subtitles increased with age
    - Longer dwell time and higher fixation count
    - Longer fixation duration
  - Time spent on reading longer and more difficult words increased with age
  - Processing effort when reading subtitles increased with age(?)
- More research on a larger sample of more diverse senior age groups, including different types of hearing loss and their onsets

Acknowledgements

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